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38

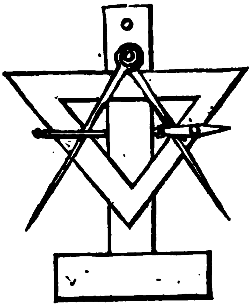
PRICED AND ILLUSTRATED CATALOGUE

OF

MATHEMATICAL INSTRUMENTS

AND

MATERIALS FOR DRAWING, SURVEYING, AND CIVIL ENGINEERING,



MADE, IMPORTED, AND SOLD, WHOLESALE AND RETAIL,

BY

JAMES W. QUEEN & CO.,

924 Chestnut and 925 Sansom Street, Philadelphia.

1883.

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581
.Q3
1883

Please let friends interested in Science see this Catalogue.

NOTICE.

THE Optical Instrument business, of which this catalogue is an exponent, was established twenty-four years ago by Mr. James W. Queen, of this city, who had been previously connected for more than a quarter of a century with the oldest Optical firm in the United States.

Though small and unpretending as his store and business were at the outset, Mr. Queen's thorough knowledge of the business, together with a full appreciation of the wants of those engaged in scientific research, soon convinced the community that his was an institution of great value; and from this small beginning rapidly grew the largest and most comprehensive establishment of the kind not only in the United States, but in the world.

The character and uses of scientific instruments are so varied and the stock so large as to require, in our establishment, their division into special departments, each of which is under the oversight of a person competent, both by his knowledge and business ability, to keep the instruments of his department up to the highest standard.

Our Spectacle Department has its competent manager and corps of assistants; and the reputation the house now enjoys is a national one for perfection of its Spectacles and Eye-glasses, and precision of adaptation to the form of the face and defects of the sight.

Our Microscope Department is now under as good management as the importance of that branch of the optical science demands, and at present we are confident that no other establishment can boast of as efficient oversight and so large and varied an assortment of instruments and accessories.

Our Mathematical Instrument Department also has its separate management and corps of assistants. The catalogue of 144 pages, representing that branch, is quite a complete manual of the instruments and their use.

Our Magic Lantern Department comprises every form of magic lantern, from the most insignificant toy to the most complete scientific instrument with accessories for lecture illustrations. The catalogue of 116 pages, besides describing the various instruments, contains a full list of photographic transparencies and colored pictures of scenery, statuary, celebrated paintings and engravings, scientific illustrations and diagrams.

Our Philosophical Department comprises all instruments designed for demonstrating the laws, principles, and facts of physical science. The catalogue of 200 pages contains an elaborate list of apparatus.

Our Meteorological Department embraces Thermometers, Barometers, Anemometers, Rain Gauges, Mining Lamps, etc. The catalogue for this department is now in press, and will shortly be ready for distribution.

It is our intention to make and sell none but perfect instruments in each of the departments of our business, and to supply to our customers the article or articles ordered or that will be best suited for the purposes wished to be accomplished.

JAMES W. QUEEN & CO.

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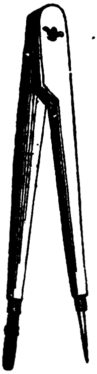
CATALOGUE OF MATHEMATICAL INSTRUMENTS.

CHAPTER I.

MATHEMATICAL INSTRUMENTS, OF BRASS,

FOR SCHOOLS.



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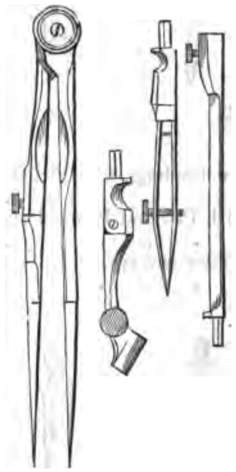

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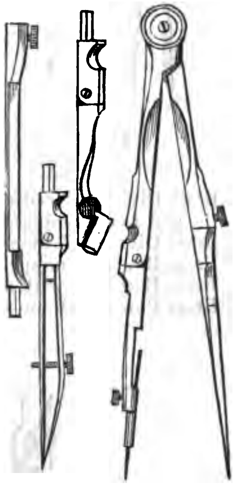

16.

No.		Price.
00.	Wood Dividers, 13 in. long, with crayon holder, for blackboard drawing,	$1.00
0.	Do. 16 do. do. do. do.	1.25
1.	Do. 20 do. do. do. do.	1.50
2.	Do. 24 do. do. do. do.	1.75
3.	Do. 27 do. do. do. do.	2.00
4.	Do. 30 do. do. do. do.	2.25
4½.	Do. 36 do. do. do. do.	2.50
5.	Brass Dividers, 3½ inches long, screw joint,	.25
6.	Do. 4½ do. do.	.30
7.	Do. 5½ do. do.	.35
8.	Do. 6½ do. do.	.45
9.	Do. 4½ do. rivet joint,	.20
10.	Do. 5½ do. do.	.25
11.	Do. 6½ do. do.	.30
12.	Do. 4½ do. screw joint and pencil leg,	.40
13.	Do. 5½ do. do. do.	.50
13½.	Do. 6½ do. do. do.	.60
14.	Brass Dividers, 4½ inches long, with Pen and Pencil Points and Lengthening Bar,	.50
15.	Brass Dividers, 6 inches long, with Pen and Pencil Points and Lengthening Bar,	.75
16.	Brass Dividers, Needle Point, 4½ inches long, with Pen and Pencil Points and Lengthening Bar,	.75

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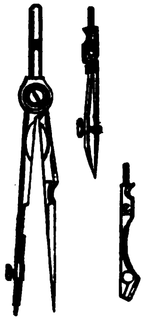

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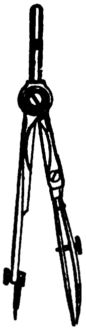

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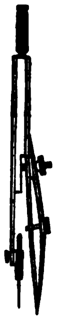

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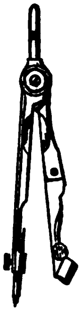
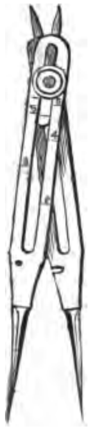


21.

No.		Price.
17.	Brass Dividers, Needle Point, 6 inches long, with Pen and Pencil Points and Lengthening Bar, ...	$1.00
18.	Brass Dividers, 3 inches long, with Pen and Pencil Points, ...	.60
19.	Brass Bow Pen, no spring, ...	.60
20.	Brass Bow Pen, with adjusting screw and spring, ...	.70
21.	Brass Bow Pencil, no spring, ...	.60



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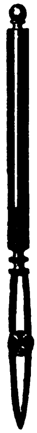

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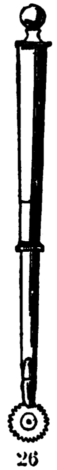

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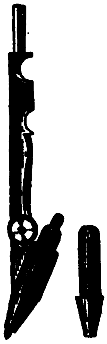
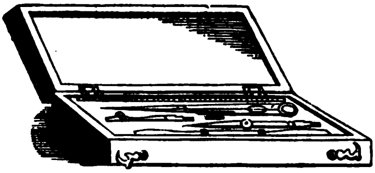


29.

22.	Brass Bisecting Dividers, ...	.60
23.	Brass Proportional Dividers, divided for lines, in case, ...	2.00
24.	Drawing Pen, black handle, ...	.20
25.	Drawing Pen, ivory handle, ...	.30
26.	Roulette, for dotting lines, ...	.65
26½.	Do. do. with three wheels, ...	.85
27.	Tracer, or Copying-wheel, for tracing patterns, ...	.25
28.	Double Drawing or Railroad Pen, for parallel lines, brass mounted, .	2.25
29.	Fox's Patent Lead Holder, for pencil leg of Dividers, ...	.25

CASES OF BRASS DRAWING INSTRUMENTS,

FOR SCHOOLS.



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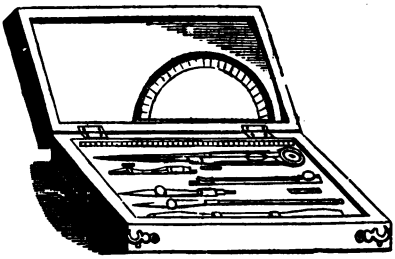

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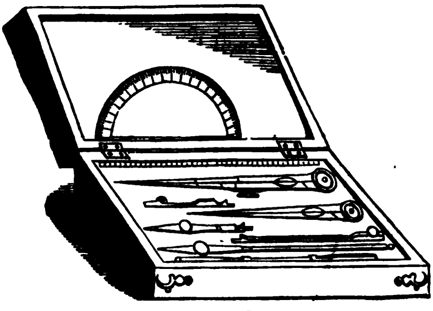
All sets of instruments from No. 48 to 64½ are fitted with Fox's Patent Lead Holder, No. 29, when sold at retail.

No.		PRICE.
48.	Wood Box; containing pair 4½-inch Dividers, with Pen and Pencil Points,	$0.50
49.	Wood Box; containing pair 4½-inch Dividers, with Pen and Pencil Points and Lengthening Bar, No. 14. Ebony handle Drawing Pen, No. 24. Brass Protractor and Divided Rule,	.80



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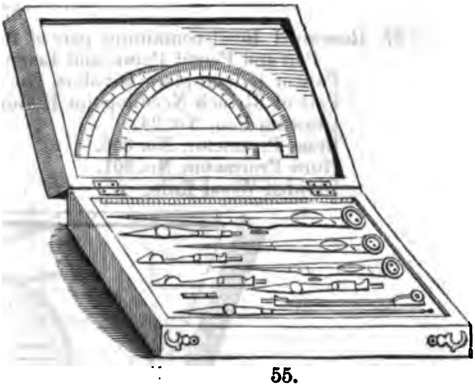


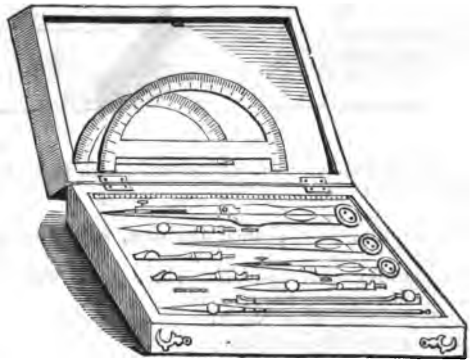
55.

No.		PRICE.
50.	Wood Box; containing pair of 4½-inch Dividers, with Pen and Pencil Points and Lengthening Bar, No. 14. Pair of 3½-inch plain Dividers, No. 5. Drawing Pen, No. 24. Brass Protractor, No. 306. Crayon Holder and Divided Rule,	1.00
51.	Rosewood Box; containing pair of 5½-inch Dividers, with Pen and Pencil Points and Lengthening Bar, No. 15. Pair of 4½-inch plain Dividers, No. 6. Drawing Pen, No. 24. Brass Protractor and Divided Rule,	1.30
52.	Same as No. 51, with Parallel Ruler,	1.50

No. PRICE.

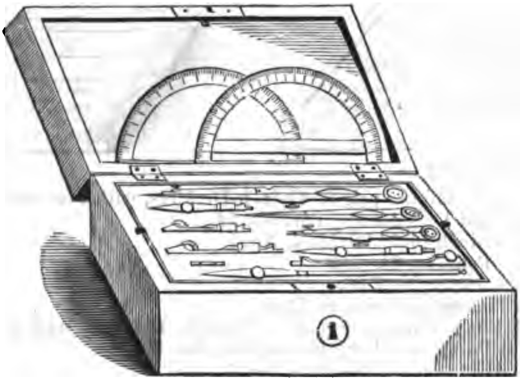
55. Rosewood Box; containing pair of 6-inch Dividers, with Pen and Pencil Points and Lengthening Bar, No. 15.
Pair of 4½-inch plain Dividers, No. 6.
Pair of 3½-inch Dividers, with Pen and Pencil Points.
Drawing Pen, No. 24.
Brass Protractor, No. 306.
Horn Protractor, No. 301.
Divided Wood Rule, ... $2.00

56. Same as No. 55, but with the instruments set in a tray, so that colors, etc., may be put below, ... 2.25



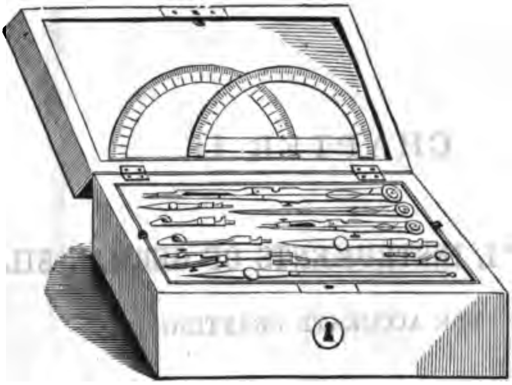
57.

57. Rosewood Box; containing pair of 6-inch Needle-point Dividers, with Pen and Pencil Points and Lengthening Bar, No. 17.
Pair of 4½-inch plain Dividers, No. 6.
Pair of 3½-inch Needle-point Dividers, with Pen and Pencil Points.
Drawing Pen, No. 24.
Brass Protractor, No. 306.
Horn Protractor, No. 301.
Divided Wood Rule, ... 2.75



58.

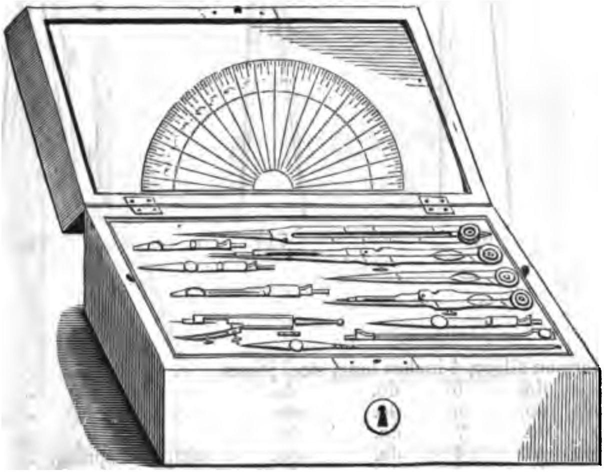
58. Same as No. 57, but with lock and key, and the instruments set in a tray, so that colors may be put below, ... 3.00



62.

No. PRICE.

62. Rosewood Box, with lock and key, the instrument set in a tray, so that colors, etc., may be put below, containing:
Pair of 6-inch Needle-point Dividers, with Pen and Pencil Points and Lengthening Bar, No. 17.
Pair of 4½-inch plain Dividers, No. 6.
Pair of 3½-inch Needle-point Dividers, with Pen and Pencil Points.
Spring Bow Pen, with Needle Point, No. 20.
Drawing Pen, No. 24.
Brass Protractor, No. 306.
Horn Protractor, No. 301.
Divided Wood Rule, ... $4.00



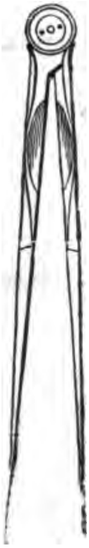
64.

64. Same as No. 62, with the addition of a pair of Proportional Dividers; has no brass Protractor, but has wood Triangle and Irregular Curves, . 6.00

CHAPTER II.

MATHEMATICAL INSTRUMENTS OF GERMAN SILVER,

FOR ACCURATE DRAFTING.



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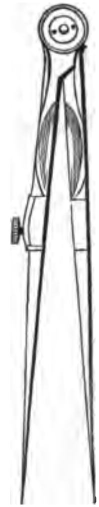

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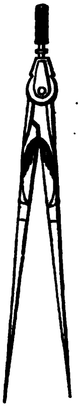
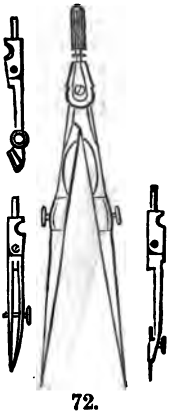
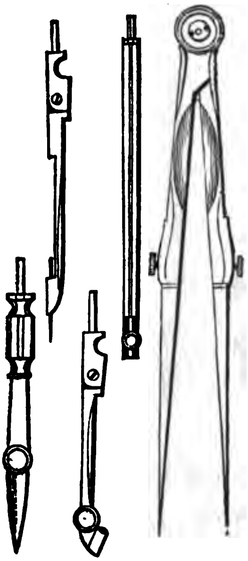


71½.



72.

No.		Price.
65.	Dividers, German silver, 4 inches long, steel joints, ...	$0.70
66.	Do. do. 5 do. do.	.80
67.	Do. do. 6 do. do.	1.00
68.	Do. do. 7 do. do.	1.25
69.	Do. do. 4 do. do. with hair spring, .	1.25
70.	Do. do. 5 do. do. do. .	1.80
71.	Do. do. 6 do. do. do. .	2.50
71½.	German silver Plain Dividers, 3 inches long, with handle, ...	.75
72.	Dividers, German silver, 3 inches long, with Pen, Pencil, and Needle Points, ...	2.50



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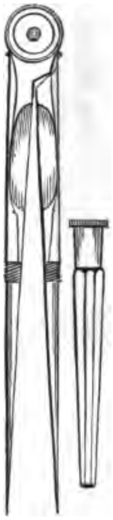

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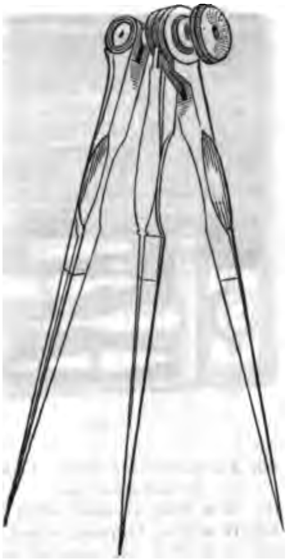
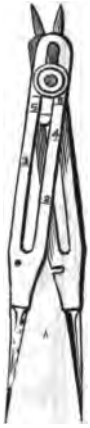
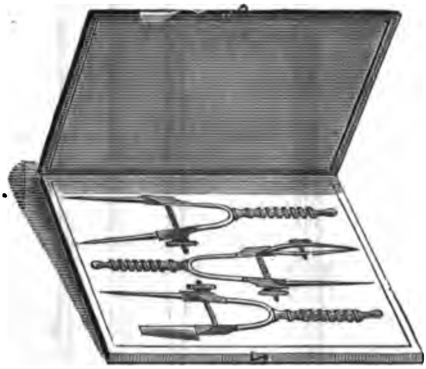


75.

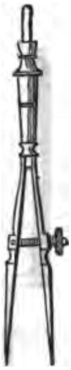
No.		Price.
73.	Dividers, German silver, 6 inches long, steel joints, with Pen, Pencil, and Needle Points and Lengthening Bar, ...	$3.00
74.	Dividers, German silver, 5 inches long, steel joints, with shield for pocket,	1.50
75	Dividers, German silver, 5 inches long, steel joints, with three legs, .	3.50



75½. 77.



77½



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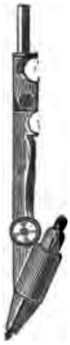

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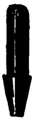
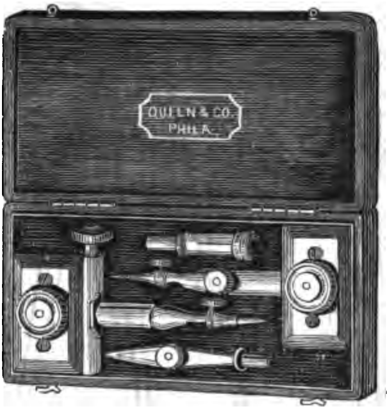


79.

75½.	Proportional Dividers, German silver, 6½ inches long, divided for lines,	2.50
77.	Bisecting Dividers, German silver, ...	1.12
77½.	Set of three Steel Bows, Pen, Pencil, and Dividers, in box, . per set,	4.75
77¾.	Same as 77½, but finer finish and Needle Points, . . . do.	6.75
78.	Spacing Dividers, all steel, with Spring and Adjusting Screw, . .	1.25
78½.	Fox's Patent Lead Holder, for pencil leg of Dividers, . . .	.25
79.	Pocket Dividers, German silver, with Folding Pen and Pencil Points,	5.50



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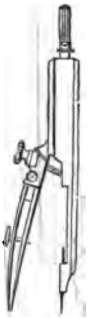


82.

83.

No.		PRICE.
80.	Furniture for Beam Compasses, German silver, with Adjusting Screw, in morocco case, ...	$5.00
81.	Bow Pen, all steel, with Spring and Adjusting Screw, ...	1.50
82.	Bow Pen, German silver, with Spring and Adjusting Screw, ...	1.62
83.	Bow Pen, German silver, with Spring and Adjusting Screw, and with Pencil Point, ...	2.50

84.

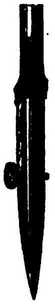
85.

86.

89.

92.

84.	Bow Pencil, all steel, with Spring and Adjusting Screw, ...	1.50
85.	Drawing Pen for curves, ...	1.50
86.	Do. for heavy border lines, ...	2.50
87.	Do. 4 to 6 inches long, medium finish, hinge to Pen, . . .	.40
88.	Do. 4 to 6 inches long, fine finish, hinge to Pen, ...	.50
89.	Do. 4 to 6 inches long, German silver, fine finish, hinge to Pen, and Protracting Pin, ...	.75



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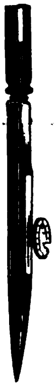

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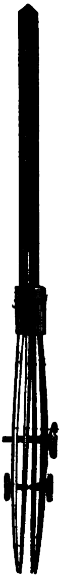

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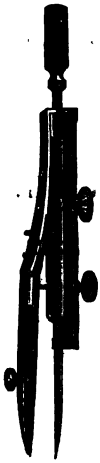

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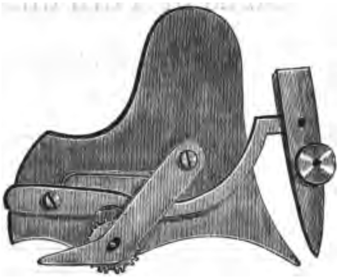
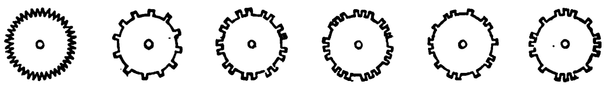


98.



98.

No.		Price.
91.	German silver, fine finish; hinge to pen. German silver Points, for red ink, ...	$0.75
91½.	Same as above, but diamond pointed; very durable, each, ...	2.00
91¾.	Queen's Improved Drawing Pen, having the screw graduated and the upper blade made to spring, so that it can be readily cleaned, each, .	1.75
92.	Double Drawing Pen, ...	2.25
93.	Patent Double Drawing Pen. Will draw with one stroke one broad or two parallel lines of the same or different widths, each, . . .	3.75
94.	Roulette for dotting lines, ...	.75
95.	Map Perambulator, for measuring the length of curved lines, rivers, roads, etc., on maps, each, ...	1.50
96.	Improved Bow Pen. The needle-point in this instrument being adjustable, it will draw extremely minute circles, ...	3.00
97.	Improved Bow Pen, same as No. 96, with pencil point, ...	4.50
98.	Dotting Pen, with extra wheels, ...	3.75

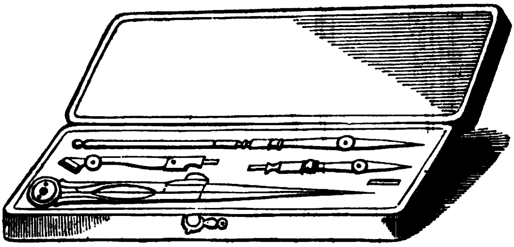
This instrument answers the purpose of making dotted lines better than any other yet made. It consists of a small, conveniently shaped German silver plate, upon which is fastened a Pen, connected by a small bar, and a ratchet movement with a rolling wheel. The bar is kept in its place by a small spring. Extra wheels of different patterns accompany the instrument, which, being readily changed, allow the making of various forms of lines. In using the instrument, care should be taken that the small point behind the pen rests on the paper, as it secures evenness in the stroke of the pen.

☞*For Boxwood and Ivory Scales, Protractors, etc., etc., see pages 38 to 41.*

Parties wishing cases made up of these Instruments, can select the pieces, by the above list, that are best adapted to their purpose, and we will have boxes made to suit, at an additional cost of from $5 to $12, according to the sizes of the boxes, which are made of rosewood, mahogany or walnut, highly finished.

CASES OF FINE GERMAN SILVER INSTRUMENTS,

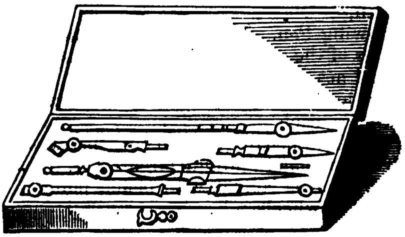
FOR ENGINEERS, ARCHITECTS, AND MACHINISTS.



100.

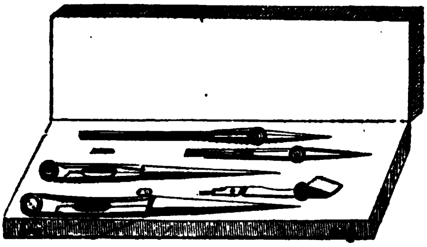
All sets of instruments from No. 100 to 134½ fitted with Fox's Patent Lead Holder, No. 78½, when sold at retail.

No.		Price.
100.	Morocco Box; containing pair of 5½-inch Dividers, with Pen and Pencil Points. Drawing Pen, No. 88, ...	$3.00



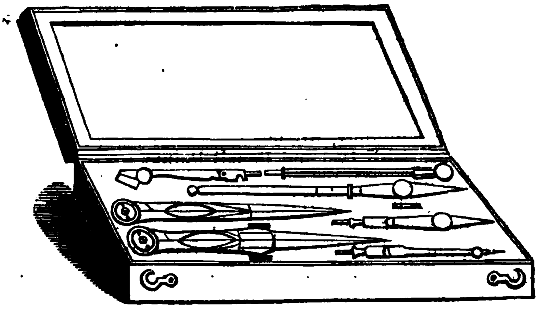
101.

No.		Price.
101.	Morocco Box; containing pair of 3-inch Dividers, with Pen, Pencil, and Needle Points and Lengthening Bar, No. 72. Drawing Pen, No. 89, ...	4.50



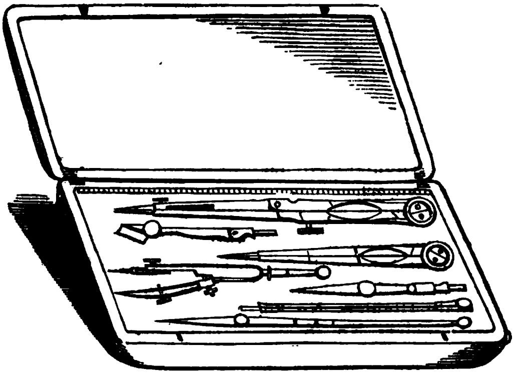
102.

No.		Price.
102.	Morocco Box; containing pair of 5½-inch Dividers, with Pen and Pencil Points, Pair of 5-inch Plain Dividers, No. 66. Drawing Pen, No. 88, ...	$3.50



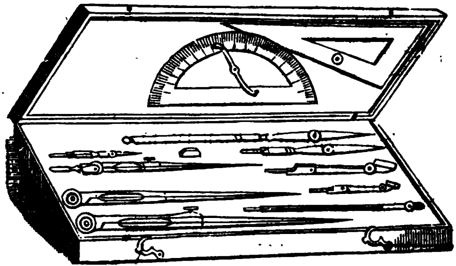
103.

No.		Price.
103.	Morocco Box; containing pair Dividers 6 inches long, with Pen, Pencil, and Needle Point and Lengthening Bar, No. 73. Pair plain Dividers, 5 inches long, No. 66. Drawing Pen, No. 89, ...	5.00
103½.	Same as No. 103, but with Polished Walnut Box, with lock and key and tray, ...	7.50



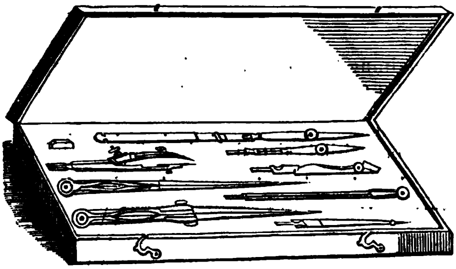
104.

No.		Price.
104.	Morocco Box, rounded corners, for carrying in the pocket; containing pair of 4¾-inch Dividers, with Hinge in one Leg, Needle Points, with Pen and Pencil Points and Lengthening Bar. Pair 4-inch plain Dividers, rounded points. Spring Bow Pen, Needle Point. Drawing Pen, Ivory Handle. 5-inch Ivory Rule, divided to eighths,	$7.50



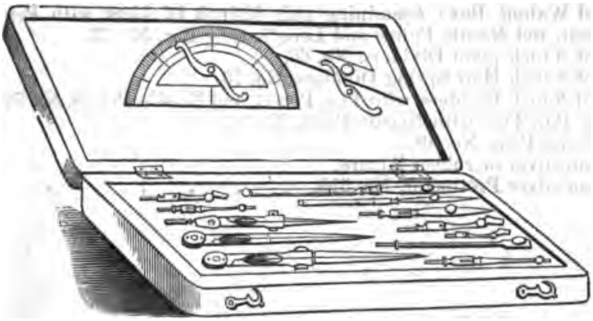
105.

No.		Price.
105.	Morocco Box; containing pair 5½-inch Dividers, with Pen and Pencil Points and Lengthening Bar. Pair of 5-inch plain Dividers, No. 66. Pair 3-inch Dividers, with Pen and Pencil Points. Drawing Pen, No. 89. German silver Protractor, No. 311. German silver, or rubber Square,	8.50
105½.	Same as No. 105, but with Polished Walnut Box, with lock and key and tray,	10.50



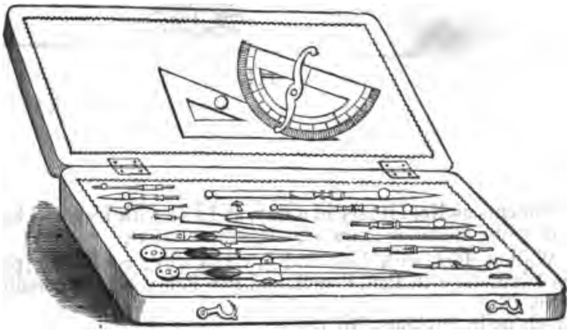
106.

No.		Price.
106.	Morocco Box; containing pair of 5½-inch Dividers, with Pen, Pencil, and Needle Points and Lengthening Bar, No. 73. Pair 5-inch plain Dividers, No. 66. Spring Bow Pen, No. 82. Drawing Pen, No. 89,	6.50
106½.	Same as No. 106, in Polished Walnut Box, with lock and key and tray,	9.00
106¾.	Morocco Box; containing pair 6-inch Dividers, with Pen, Pencil, and Needle Points and Lengthening Bar, No. 73. Pair 5-inch plain Dividers, No. 66. Pair Spacing Dividers, No. 78. Bow Pen, No. 81. Bow Pencil, No. 84. Drawing Pen, No. 88,	10.00



107.

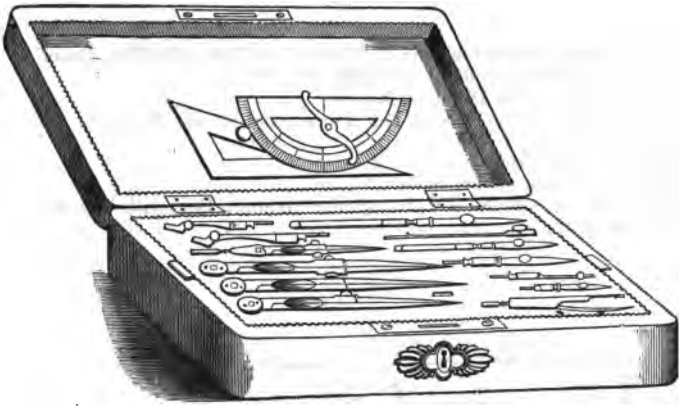
No.		Price.
107.	Morocco Box; containing pair of 5½-inch Dividers, with Pen, Pencil, and Needle Points and Lengthening Bar, No. 73. Pair of 5-inch plain Dividers, No. 66. Pair of 3-inch Dividers, with Pen, Pencil, and Needle Point, No. 72. 2 Drawing Pens, No. 89. German silver Protractor, No. 310. German silver or rubber Square,	$9.75
108.	Same instruments as No. 107, in Polished Walnut Box, with lock and key and tray,	11.75



109.

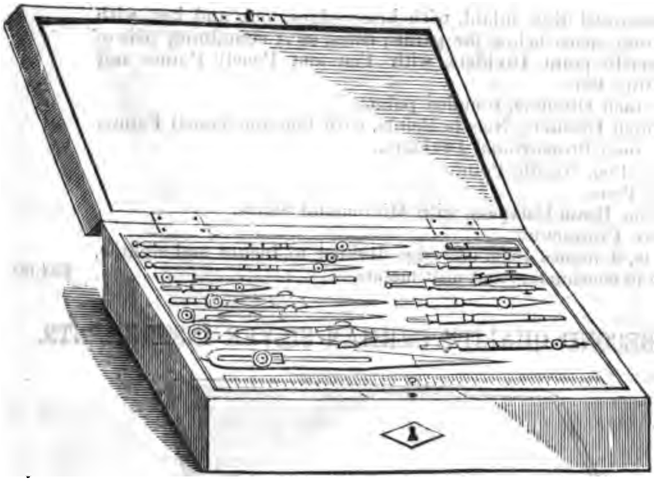
No.		Price.
109.	Polished Walnut Box; containing pair of 5½-inch Dividers, with Pen, Pencil, and Needle Points and Lengthening Bar, No. 73. Pair 5-inch plain Dividers, No. 66. Pair of 3-inch Dividers, with Pen, Pencil, and Needle Points, No. 72. Spring Bow Pen, with Needle Point, No. 82. 2 Drawing Pens, No. 89. German silver or rubber Square. German silver Protractor, No. 310,	12.50
109½.	Same as No. 109, in Polished Walnut Box, with lock and key and tray,	13.50

No.		PRICE.
110.	Polished Walnut Box; containing pair 5½-inch Dividers, with Pen, Pencil, and Needle Points and Lengthening Bar, No. 73. Pair of 5-inch plain Dividers, No. 66. Pair of 5-inch Hair Spring Dividers, No. 70. Pair of 3-inch Dividers, with Pen, Pencil, and Needle Points, No. 72. Spring Bow Pen, with Needle Point, No. 82. 2 Drawing Pens, No. 89. German silver or rubber Square. German silver Protractor, No. 310, ...	$15.00



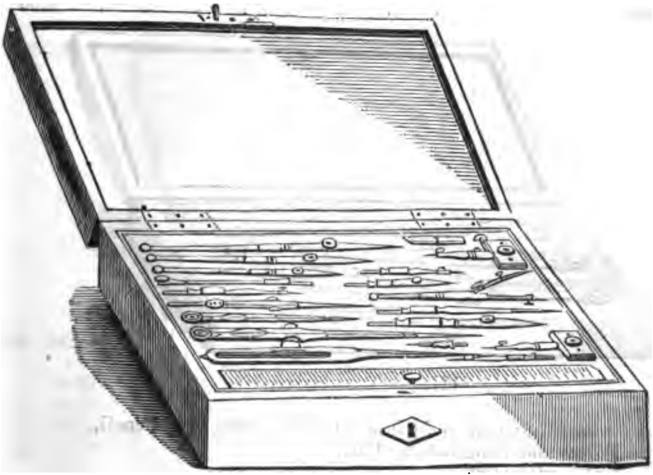
111.

111.	Same instruments as No. 110, set in a tray, and box with lock and key, thus affording space for extra instruments or colors, . . .	15.50
112.	Polished Walnut Box, with lock and key and tray; containing pair 6-inch Dividers, with Pen, Pencil, and Pen Point and Lengthening Bar, No. 73. Pair 5-inch plain Dividers, No. 66. Pair 5-inch Hair Spring Dividers, No. 70. Pair 3-inch Dividers, with Pen, Pencil, and Needle Point, No. 72. Bow Pen, No. 82. 2 Drawing Pens, No. 89. 1 Red Ink Pen, No. 91. 1 Road Pen, No. 93. Pair Proportional Dividers, No. 75½. Protractor, No. 311. Triangle, No. 565. Triangular Scale, No. 463 or 466, ...	26.00
113.	Same as No. 112, with addition of Beam Compass, No. 80, . . .	31.00



114.

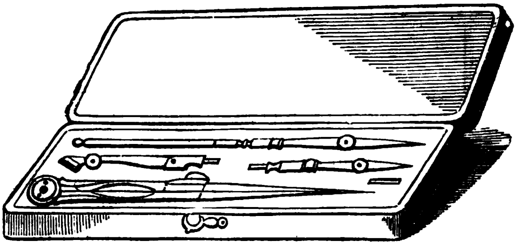
No.		Price.
114.	Polished Rosewood Box, inlaid, lock and key, with tray, leaving space below for paints, rules, etc.; containing pair 6½-inch Needle-point Dividers, with Pen and Pencil Points and Lengthening Bar. Pair of 4½-inch plain Dividers. Pair of 4-inch Needle-point Dividers, with Pen and Pencil Points. Pair of 7-inch Proportional Dividers. 3 Drawing Pens. Horn Protractor. 1 Wood Curve and 2 Wood Squares. Spring Bow Pen. Ivory Rule, 8 inches long, ...	$27.00



116,

116. Polished Rosewood Box, inlaid, with brass edges, lock and key, with tray, leaving space below for paints, rules, etc.; containing pair of 6-inch Needle-point Dividers, with Pen and Pencil Points and Lengthening Bar.
Pair of 4½-inch Dividers, rounded points.
Pair of 4-inch Dividers, Needle Points, with Pen and Pencil Points.
Pair of 7½-inch Proportional Dividers.
Spring Bow Pen, Needle Point.
3 Drawing Pens.
Furniture for Beam Compass, with Micrometer Screw.
9-inch Horn Protractor.
Ivory Scale, 8 inches long, one edge divided to inches and eighths, the other to centimeters and millimeters, ... $34.00

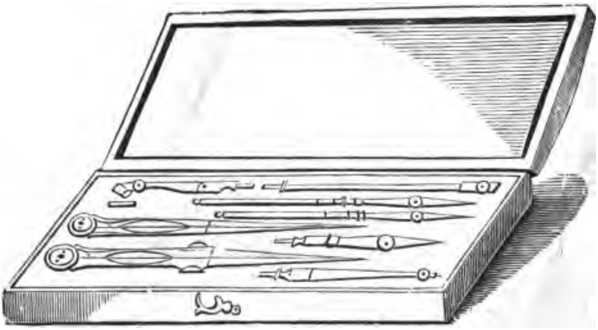
CASES OF SECOND QUALITY GERMAN SILVER INSTRUMENTS.



125.

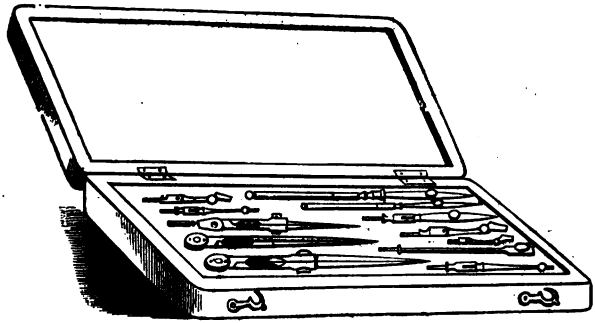
125. Morocco Box; containing pair of 5½-inch Dividers, with Pen and Pencil Points.
Drawing Pen, ... 2.00

126. Morocco Box; containing pair of 5½-inch Dividers, with Pen and Pencil Points and Lengthening Bar.
Pair of 5-inch plain Dividers.
Drawing Pen, ... 3.00



127.

127. Morocco Box; containing pair of 5½-inch Dividers, with Pen, Pencil, and Needle Points and Lengthening Bar.
Pair of 5-inch plain Dividers.
2 Drawing Pens, ... 4.00



128.

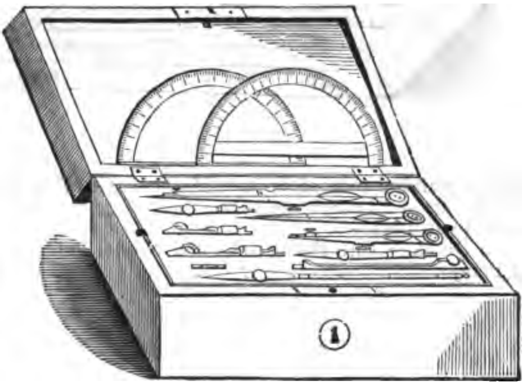
No.		PRICE.
128.	Morocco Box; containing pair of 5½-inch Dividers, with Pen, Pencil, and Needle Points and Lengthening Bar. Pair of 5-inch plain Dividers. Pair of 4-inch Dividers, with Pen, Pencil, and Needle Points. 2 Drawing Pens, ...	$6.50

130.

129.	Morocco Box; containing pair of 5½-inch Dividers, with Pen, Pencil, and Needle Points and Lengthening Bar. Pair of 5-inch plain Dividers. Pair of 4-inch Dividers, with Pen, Pencil, and Needle Points. Pair Spacing Dividers. Bow Pen. Bow Pencil. 2 Drawing Pens, ...	10.00

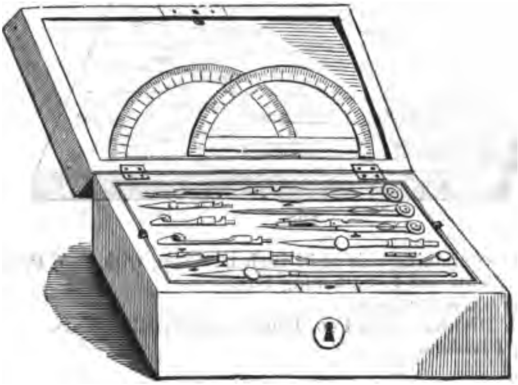
No. PRICE

130. Morocco Box; containing pair 5½-inch Dividers, with Pen, Pencil, and Needle Points and Lengthening Bar.
Pair 5-inch plain Dividers.
Pair 5-inch Hair-spring Dividers.
Pair 4-inch Dividers, with Pen, Pencil, and Needle Points.
Pair Spacing Dividers.
Bow Pen.
Bow Pencil.
2 Drawing Pens, ... $12.50



132.

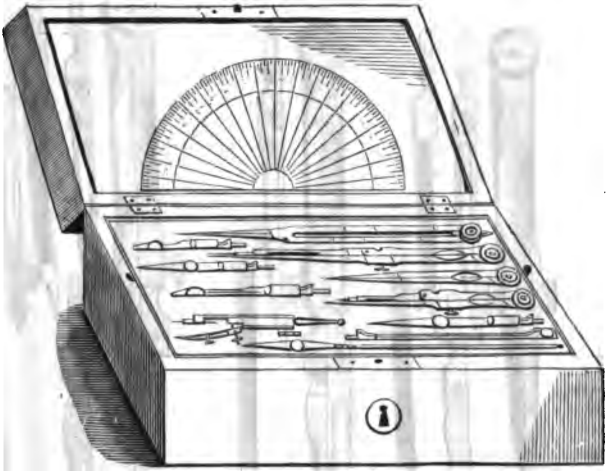
132. Rosewood Box, with lock and key and the instruments set in a tray, so that colors, etc., may be put below; containing pair of 6-inch Needle-point Dividers, with Pen and Pencil Points and Lengthening Bar.
Pair of 4½-inch plain Dividers.
Pair of 3½-inch Needle-point Dividers, with Pen and Pencil Points.
Drawing Pen.
Brass Protractor.
Horn Protractor, ... 6.75



133.

No. PRICE.

133. Rosewood Box, with lock and key, the instruments set in a tray, so that colors, etc., may be put below; containing pair of 6-inch Needle-point Dividers, with Pen and Pencil Points and Lengthening Bar.
Pair of 4½-inch plain Dividers.
Pair of 3½-inch Needle-point Dividers, with Pen and Pencil Points.
Spring Bow Pen, with Needle-point.
Drawing Pen.
Brass Protractor.
Horn Protractor, ... $7.50



134.

134. Rosewood Box, with lock and key, the instruments set in a tray, so that colors, etc., may be put below; containing pair of 6-inch Needle-point Dividers, with Pen and Pencil Points and Lengthening Bar.
Pair of 4½-inch plain Dividers.
Pair of 3½-inch Needle-point Dividers, with Pen and Pencil Points.
Spring Bow Pen, with Needle Point.
Drawing Pen.
German silver Protractor.
Horn Protractor.
Irregular Curve of Wood.
2 Triangles of Wood.
Pair Proportional Dividers, 7½ inches long, ... 10.75

CHAPTER III.

JAMES W. QUEEN & CO. ARE SOLE AGENTS BY APPOINTMENT IN PHILADELPHIA, AND PRINCIPAL AGENTS IN THE UNITED STATES, FOR THE

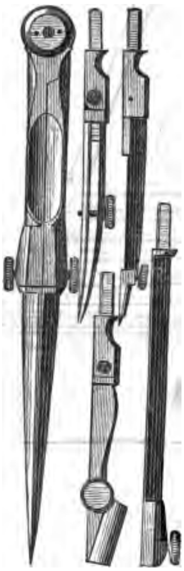
CELEBRATED SWISS DRAWING INSTRUMENTS.

Although there are several makers of drawing instruments in Switzerland, yet there is but one manufacturer whose instruments uniformly come up to a standard of absolute perfection in quality of material and excellence of finish. The divider joints work regularly and smoothly, the points are carefully tempered and rounded, the pens dressed to draw a smooth line of any thickness in whatever position held.

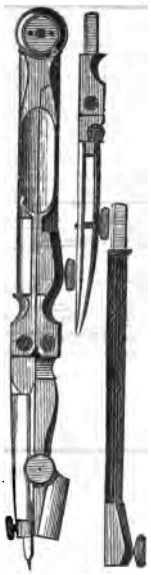
Other Swiss manufacturers imitate the form of these instruments, but cannot imitate their perfection in finish.

145.

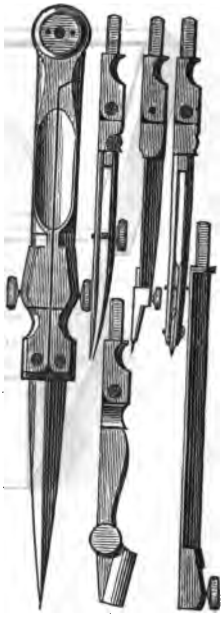
148.



150.

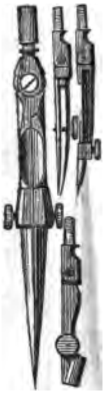


151.



152.

No.		Price.
145.	Plain Dividers, 4½ inches long, each,	$1.50
146.	Plain Dividers, 5 inches long, each,	1.75
147.	Plain Dividers, 6 inches long, each,	2.50
148.	Hair Spring Dividers, 4½ inches long, each,	2.25
149.	Hair Spring Dividers, 5 to 6 inches long, each,	2.50
150.	Dividers, 6½ inches long, with Pen, Pencil, Needle Points, and Lengthening Bar,	6.50
151.	Dividers, 6½ inches long, with fixed Needle Point and Loose Pen, and Pen Points and Lengthening Bar,	6.00
152.	Dividers, 6½ inches long, joints in each leg, with Pen, Pencil, Needle Points, Dotting Pen, and Lengthening Bar,	9.00



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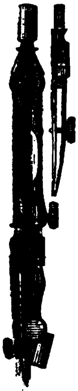

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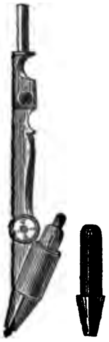


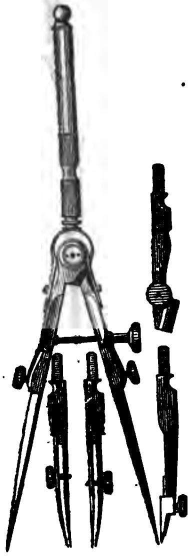
154½.

No.		Price.
153.	Dividers, 4 inches long, with Pen, Pencil, and Needle Points, . . .	$5.00
154.	Dividers, 4 inches long, with fixed Needle Point, and Pen and Pencil Points, changeable, ...	4.50
154½.	Fox's Patent Lead Holder for pencil leg of Dividers, ...	.25

155.

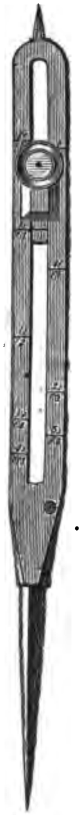
156.

157.



158.

155.	Dividers, 4 inches long, with two fixed Needle Points, ...	3.00
156.	Dividers, 4 inches long, with fixed Needle Point and Pen Point, . .	3.00
157.	Dividers, 4 inches long, with fixed Needle Point and Pencil Point, .	3.00
158.	Dividers, 4 inches long, with Spring and Set Screw, Needle Point, Pencil Point, and two Pen Points, ...	7.00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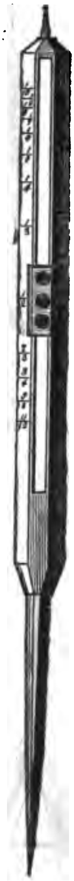
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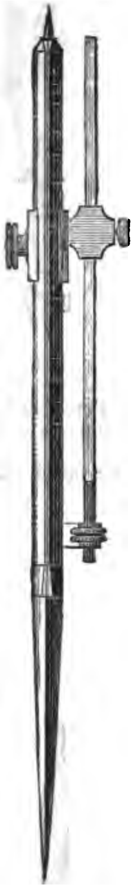
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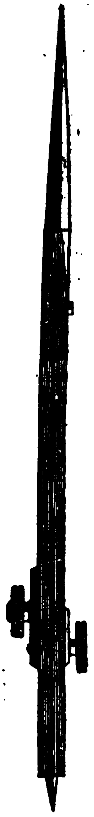
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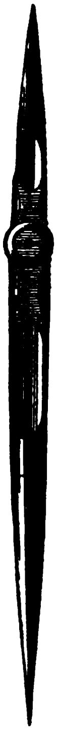
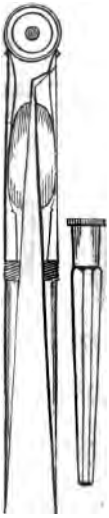

164.

No.		PRICE.
159.	Proportional Dividers, 6½ inches long, finely graduated for lines, . .	$8.00
160.	Proportional Dividers, 6½ inches long, finely graduated for lines and polygons, ...	9.00
161.	Proportional Dividers, 9 inches long, finely graduated for lines and polygons, ...	10.00
162.	Proportional Dividers, 9 inches long, with micrometer adjustment, finely graduated for lines and polygons, ...	12.00
163.	Proportional Dividers, 8 inches long, with rack adjustment, graduated for lines, ...	10.50
164.	Bisecting Dividers, 7½ inches long, each, ...	4.25



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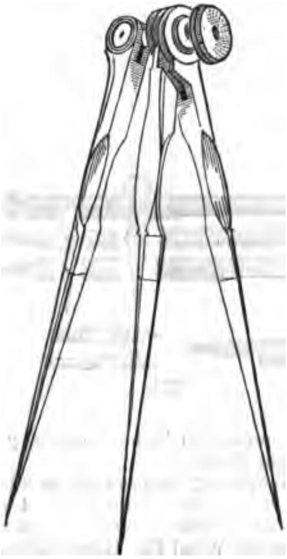
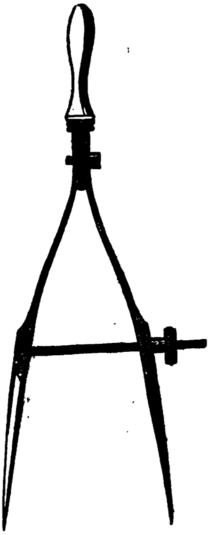


166.

No.		Price.
165.	Pocket Dividers, 5 to 6 inches long, with Sheath, each,	$2.40
166.	Three-legged Dividers, 5 to 6 inches long, each,	4.25



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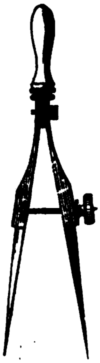
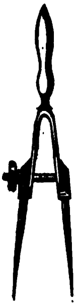
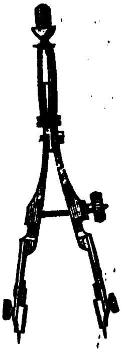


168.

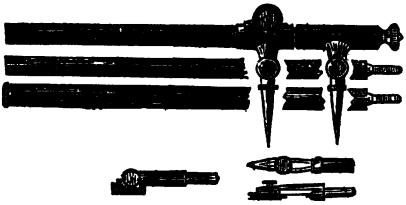


168½.



169.

167.	Steel-spacing Dividers, 5 inches long, with Ivory Handle,	2.50
168.	Steel-spacing Dividers, 3½ inches long, with Ivory or Metal Handle,	1.50
168½.	Very delicate Steel-spacing Dividers, 2½ inches long,	1.70
169.	Steel-spacing Dividers, 3½ inches long, with Ivory Handle and Needle Points,	2.50



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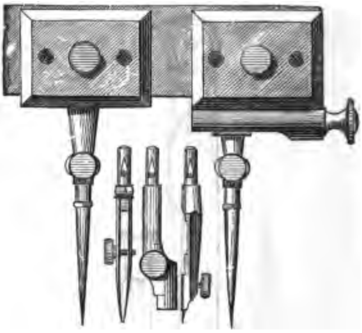
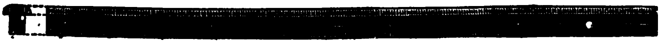


174.

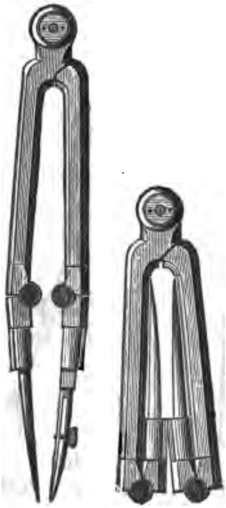
No.		PRICE.
170.	Beam Compass, 20 inches long, in 2 bars, with Pen, Pencil, and two Straight Points,	$9.25
171.	Beam Compass, 21 inches long, in 3 bars,	10.50
172.	Do. do. 36 do. 4 do.	15.00
173.	Do. do. 54 do. 4 do.	21.00
174.	Furniture for Wood Bar Beam Compasses, in morocco box,	7.00



174½.

174½. Hardwood Bars for Beam Compasses,

	24	30	36	42	48	60 inch.
each,	.75	.85	$1.00	1.25	1.35	1.50



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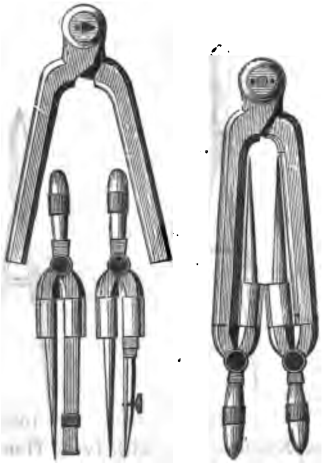

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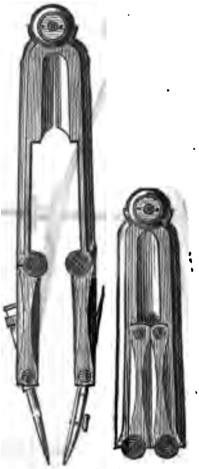
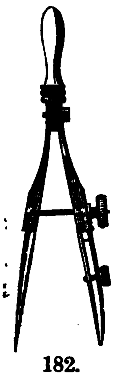


181.

No.		Price.
175.	Furniture for Wood Bar Beam Compasses, not in morocco box, . .	$6.75
179.	Pillar Compasses, or Pocket Set of Instruments, with Points to change,	7.50
180.	Pillar Compasses, or Pocket Set of Instruments, with Points to change, and Handles to Bow Pen and Pencil, ...	8.00
181.	Pillar Compasses, or Pocket Set of Instruments, with Points to turn, .	7.50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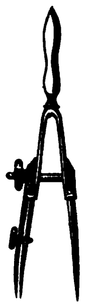
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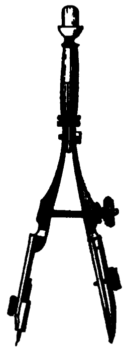
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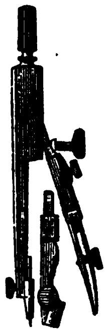
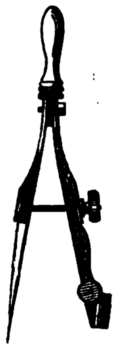
184.


185.

182.	Spring Bow Pen, all steel, Ivory Handle, ...	2.00
182½.	Very delicate Steel Bow Pen, 2½ inches long, ...	2.25
183.	Spring Bow Pen, with Needle Point, all steel, Ivory Handle, . .	2.40
184.	Do. do. German Silver, ...	2.00
185.	Do. do. do. with Pencil Point, ...	3.00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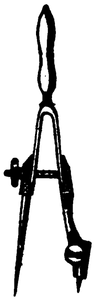
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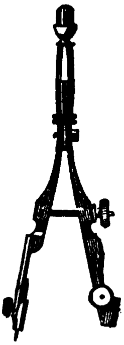
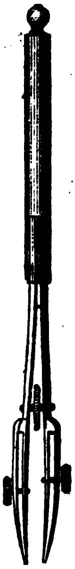

187.

188.

189.

190.

186.	All Steel Spring Bow Pencil, Ivory Handle, ...	2.00
186½.	Very delicate Steel Bow Pencil, 2½ inches long, ...	2.25
187.	All Steel Spring Bow Pencil, Ivory Handle, Needle Point, . . .	2.40
188.	Drawing Pen, 4½ inches long, with joints, ...	1.25
189.	Do. 5½ do. do.	1.40
190.	Do. 6½ do. do.	1.60



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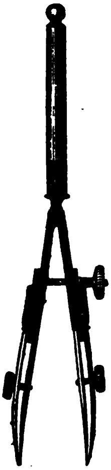

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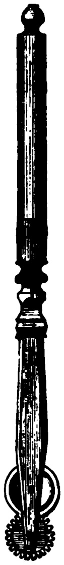

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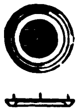
194½.



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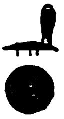

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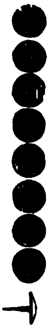
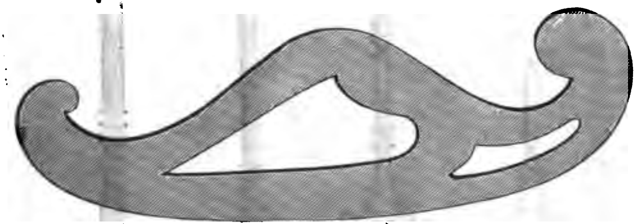
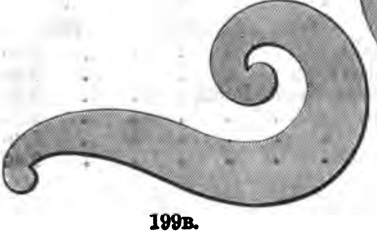


197.

No.		Price.
191.	Road, or Double Drawing Pen,	$3.75
192.	Do. do. do. with joint in each side,	3.00
193.	Dotting Pen, with one wheel,	2.00
194.	Do. with six wheels,	3.50
194½.	Do. with three wheels,	3.75
195	Horn Centre, with German Silver edges,	.40
196.	German Silver Centre, with handle,	.60
197.	Do. Fastening Tacks, per dozen,	.60
198.	Steel Fastening Tacks, per dozen,	.60



199A.



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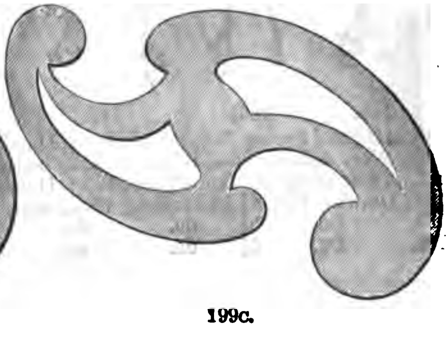
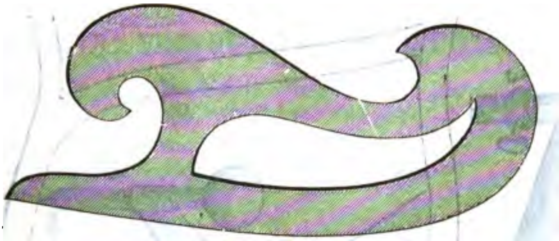


199C.



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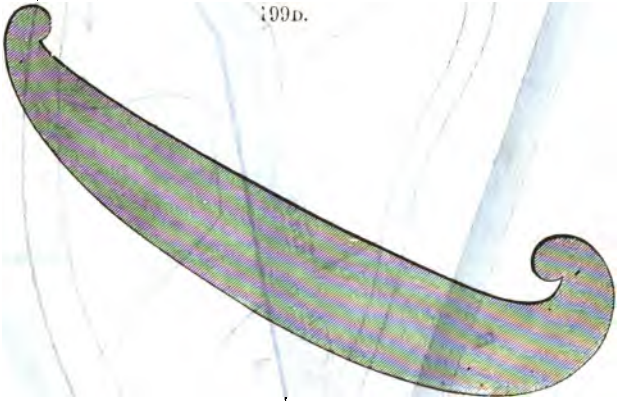
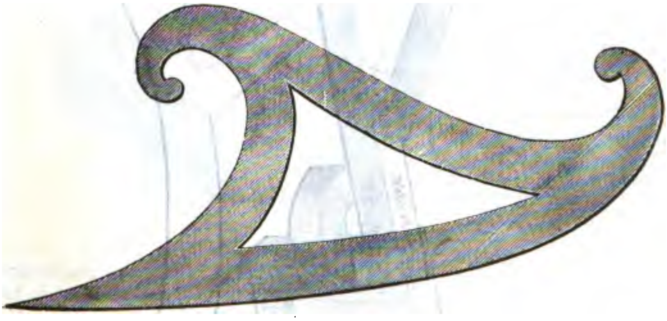


199E.



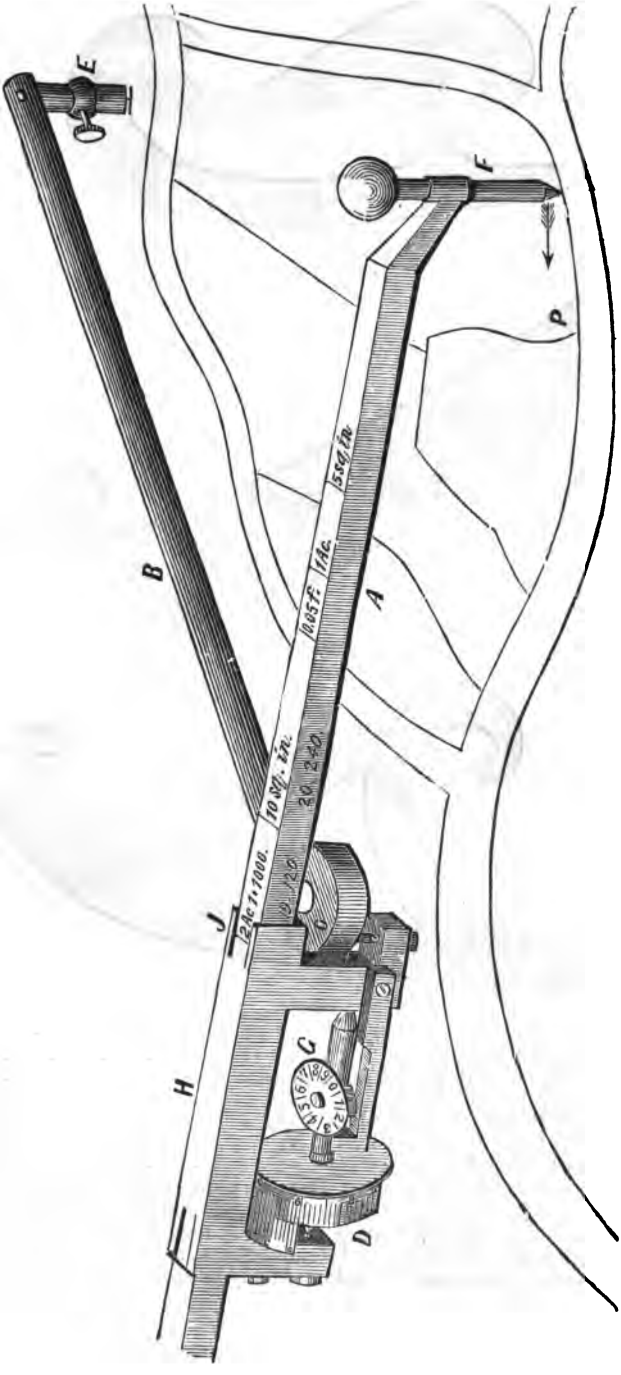
199F.

No.		Price.
199.	Irregular Curves of Horn, each,	$0.75
200.	Rolling Parallel Rule, ebony,	3.00
201.	Polar Planimeter, with printed instructions,	30.00
202.	Eccentric Rule, 11 inches long,	2.00
203.	Steel Needle Points for Divider legs, each,	.15
204.	Tracer, with Ivory Handle, each,	1.50
205.	Pricker, with Ivory Handle, each,	2.00

☞ *For Boxwood and Ivory Scales, Protractors, etc., etc., see pages 38 to 42.*

Parties wanting cases made up of these instruments can select the pieces by the above list that are best adapted to their purpose, and we will have boxes made to suit, at an additional cost of from $7 to $15, according to the sizes of the boxes, which are made of rosewood, mahogany or walnut, highly finished.

AMSLER'S POLAR PLANIMETER.



No. 201.

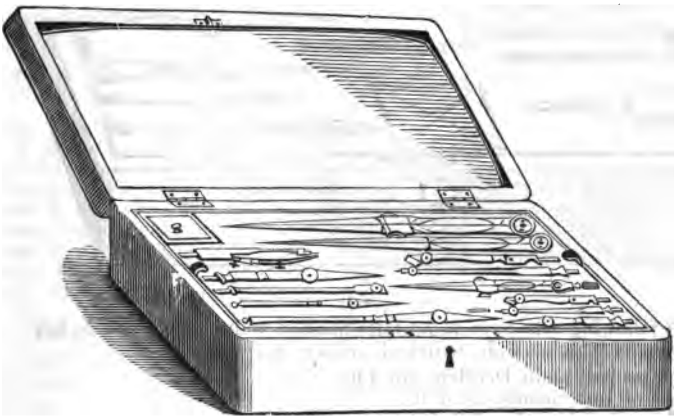
SETS OF EXTRA FINE SWISS DRAWING INSTRUMENTS.

No. PRICE.

The following sets have beautifully finished Walnut Boxes, 9½ inches long by 6 inches wide, with lock and key and tray.

250. Contains pair plain Dividers, No. 146.
Set of Instruments, No. 150.
Steel Spacing Divider, No. 168.
Steel Bow Pen, No. 182.
Steel Bow Pencil, No. 186.
Drawing Pen, No. 189.
Triangular Scale, No. 464 or 467. . . . . $21.00

251. Contains pair plain Dividers, No. 146.
Set of Instruments, No. 150.
Do. No. 153.
Drawing Pen, No. 188.
Do. No. 190.
Triangular Scale, No. 464 or 467, ... 22.00



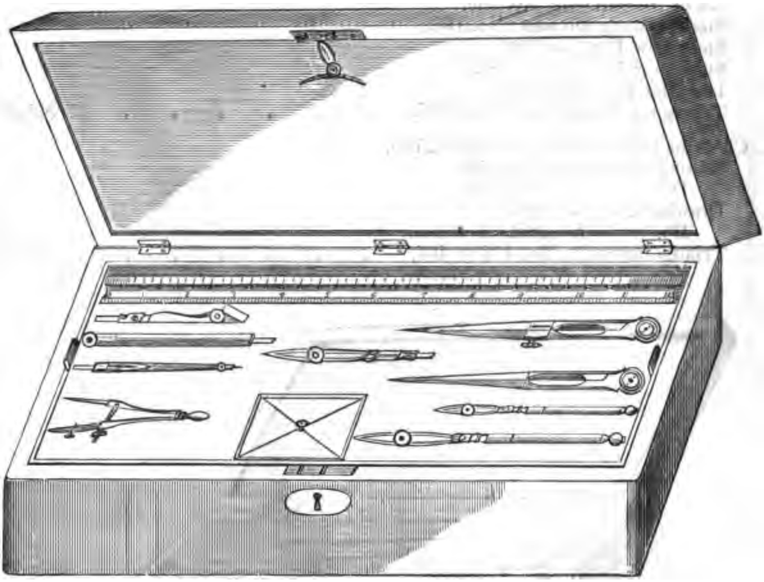
253.

253. Contains pair plain Dividers, No. 146.
Set of Instruments, No. 150.
Do. No. 153.
Bow Pen, No. 184.
Drawing Pen, No. 188.
Do. No. 190.
Triangular Scale, No. 464 or 467, ... 24.00

254. Contains pair plain Dividers, No. 146.
Pair Hair Spring Dividers, No. 149.
Set of Instruments, No. 150.
Steel Spacing Dividers, No. 168.
Steel Bow Pen, No. 182.
Steel Bow Pencil, No. 186.
Drawing Pen, No. 188.
Do. No. 190.
Triangular Scale, No. 464 or 467, ... 25.00

No. **PRICE.**

255. Contains pair plain Dividers, No. 146.
Pair Hair Spring Dividers, No. 149.
Set of Instruments, Nos. 150 and 153.
Bow Pen, No. 184.
Drawing Pens, Nos. 188 and 190.
Triangular Scale, No. 464 or 467, ... $28.00



260.

The following sets have beautifully finished walnut boxes, 13 inches long by 6 inches wide, with lock and key and tray:

260. Contains pair plain Dividers, No. 146.
Set of Instruments, No. 150.
Steel Bow Pen, No. 182.
Drawing Pens, Nos. 188 and 189.
Triangular Scale, No. 463 or 466, ... 20.00

261. Contains pair plain Dividers, No. 146.
Set of Instruments, Nos. 150 and 153.
Steel Bow Pen, No. 182.
Steel Bow Pencil, No. 186.
Drawing Pens, Nos. 188 and 189.
Triangular Scale, No. 463 or 466, ... 26.50

The following sets have beautifully finished rosewood boxes, 13 inches long by 7½ inches wide, with lock and key and tray:

262. Contains pair plain Dividers, No. 146.
Pair Hair Spring Dividers, No. 149.
Set of Instruments, Nos. 150 and 153.
Pair Steel Spacing Dividers, No. 168.
Steel Bow Pen, No. 182.
Steel Bow Pencil, No. 186.
Drawing Pens, Nos. 188, 189, and 190.
Triangular Scale, No. 463 or 466, ... 33.00

No. PRICE.

263. Contains pair plain Dividers, No. 146.
Pair Hair Spring Dividers, No. 149.
Set of Instruments, Nos. 150 and 153.
Proportional Dividers, No. 159.
Steel Spacing Dividers, No. 168.
Steel Bow Pen, No. 182.
Steel Bow Pencil, No. 186.
Drawing Pens, Nos. 188, 189, and 190.
Triangular Scale, No. 463 or 466, ... $40.00

264. Contains pair plain Dividers, No. 146.
Pair Hair Spring Dividers, No. 149.
Set of Instruments, Nos. 150 and 153.
Proportional Dividers, No. 160.
Steel Spacing Dividers, No. 168.
Steel Bow Pen, No. 182.
Steel Bow Pencil, No. 186.
Beam Compass, No. 171.
Drawing Pens, Nos. 188, 189, and 190.
Road Pen, No. 192.
Dotting Pen, No. 196.
Triangular Scale, No. 463 or 466, ... 57.00

The following set has beautifully finished Rosewood box, 15½ inches long by 10 inches wide, with lock and key and tray, and lined with finest silk velvet.

265. Contains pair plain Dividers, No. 146
Pair Hair Spring Dividers, No. 149.
Set of Instruments, No. 152.
Proportional Dividers, No. 162.
Steel Spacing Dividers, Nos. 167 and 168.
Beam Compass, No. 172.
Steel Bow Pen, No. 182.
Set of Instruments, No. 158.
Steel Bow Pencil, No. 186.
Drawing Pens, Nos. 188, 189, and 190.
Road Pen, No. 191.
Dotting Pen, with 6 wheels, No. 194.
Protractor.
Triangular Scale, No. 463 or 466.
Set of Color Cups, ... 95.00

Finely Polished Rosewood or Black Walnut Cases, with German silver straps and corners, and lined with silk velvet, fitted up to order with such instruments as may be selected from Catalogue.

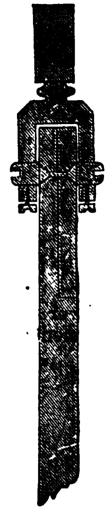
Extra Sets for Presentation a specialty.

CHAPTER IV.

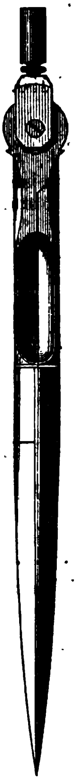
ALTENEDER'S PATENT JOINT DRAWING INSTRUMENTS.

The excellency of these instruments consists in the joints of the dividers being so constructed as to prevent any irregular motion when the legs are opened or closed, also for the general care with which the instruments are finished.

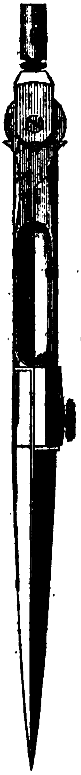
All the pens are thoroughly well made and pointed. No. 275 represents a sectional view of Alteneder's Patent Joint Divider Head.


275.

276.

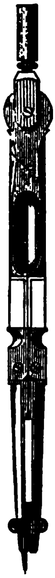

278.

279.


281.

No.		PRICE.
276.	Plain Dividers of German Silver, 3½ inches long, with Alteneder's patent joint, each, ...	$2.00
277.	Plain Dividers of German Silver, 5 inches long, with Alteneder's patent joint, each, ...	2.75
278.	Plain Dividers of German Silver, 6 inches long, with Alteneder's patent joint, each, ...	3.25

No.		Price.
279.	Hair Spring Dividers of German Silver, 3½ inches long, with Alteneder's patent joint, each, ...	$3.00
280.	Hair Spring Dividers of German Silver, 5 inches long, with Alteneder's patent joint, each, ...	3.50
281.	Hair Spring Dividers of German Silver, 6 inches long, with Alteneder's patent joint, each, ...	4.00



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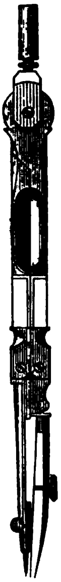

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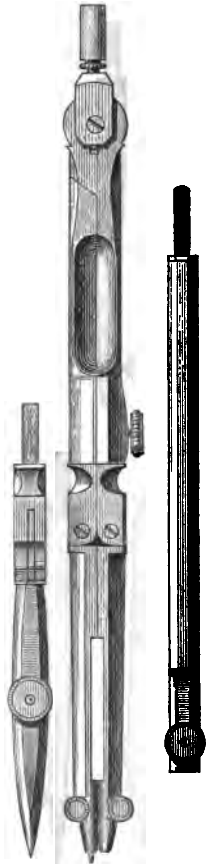
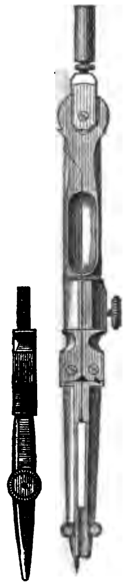


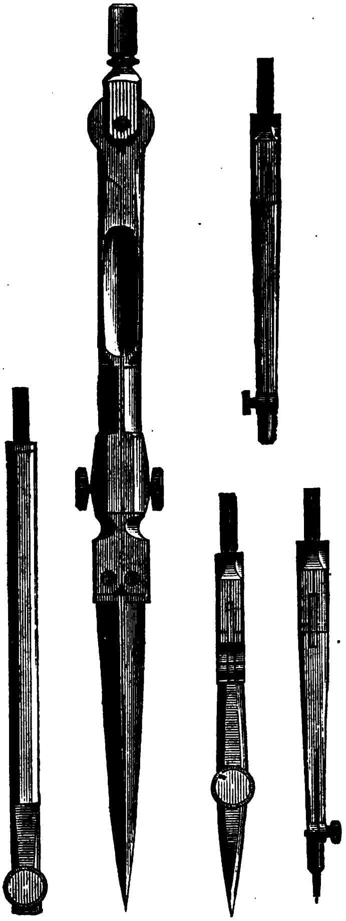
284.



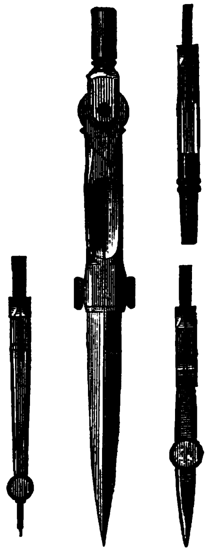
284½.

No.		Price.
282.	Needle Point Dividers, 3½ inches long, of German Silver, with Pencil Point and Alteneder's patent joint, each, ...	4.25
283.	Needle Point Dividers, 3½ inches long, of German Silver, with Pen Point and Alteneder's patent joint, each, ...	4.75
284.	Needle Point Dividers, 6 inches long, of German Silver, with Pen and Pencil Point and Lengthening Bar, and Alteneder's patent joint, .	7.50
284 A.	Dividers, 6½ inches long, with Pen, Pencil, Needle Points, and Lengthening Bar, ...	8.50

No.		Price
284 B.	Same as 284 A, but with joint in each leg of Divider, as in No. 152,	$11.00
284 C.	Dividers, 3½ inches long, with Pen, Pencil, and Needle Point, . .	7.00
284½.	Needle Point Dividers, 3½ inches long, of German Silver, with Pen and Pencil Point, and Alteneder's patent joint, ...	6.00
285.	Steel Spacing Dividers, 3 inches long, ...	1.75

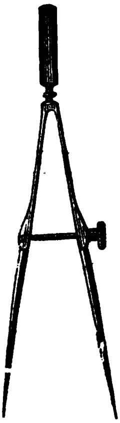


284 B.



284 C.

286.	Steel Bow Pen, 3 inches long, round point, ...	2.25
287.	Do. do. 3 inches long, with Needle Point, ...	2.75
288.	Steel Bow Pencil, 3 inches long, with round point, ...	2.25
289.	Do. do. 3 inches long, with Needle Point, ...	2.75
290.	Drawing Pens, 4½ inches long, ...	1.50
291.	Do. 5½ do.	1.70
292.	Do. 6½ do.	1.90



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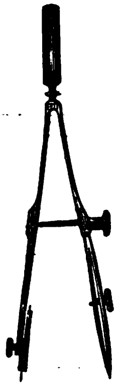

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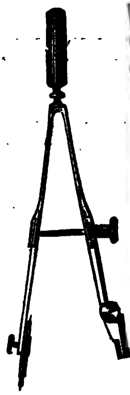
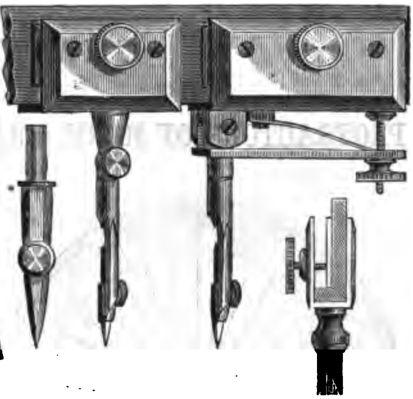


289.

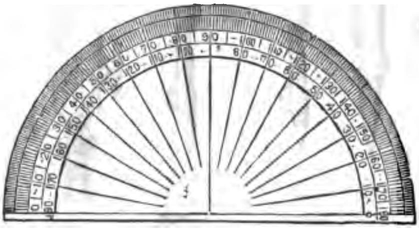


293.

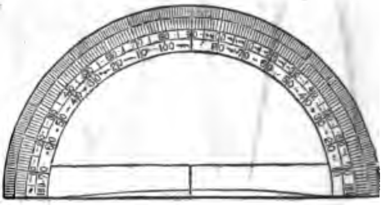
No.		PRICE.
293.	Furniture for Straight-edge Beam Compasses, with Spring Adjustment, in morocco box, ...	$8.00
294.	Mahogany Bar, 30 inches long, for do., ...	.75
295.	Boxwood Bar, 24 inches long, graduated, ...	2.50

CHAPTER V.

PROTRACTORS OF HORN, BRASS, AND GERMAN SILVER.



301.



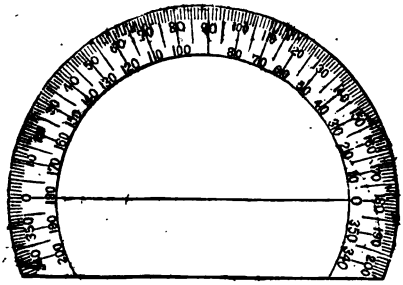
307.

No.		PRICE.
297.	Railroad Curve Protractor, of horn, 8 inches diameter, having laid off on it twenty-three curves from ½ degree to 8 degrees, with a radius of 400 feet to the inch, ...	$1.60
297½.	Horn Rectangular Protractor, 6 inches long, 2½ inches wide, divided around edge from 0 to 180 degrees, in — degrees, ...	.50
298.	Horn Protractors, 5 inches diameter, whole circle, half degrees, . .	1.00
299.	Do. 6 do. do. do. . .	1.25
300.	Do. 7 do. do. do. . .	1.50
301.	Horn Protractor, 4 do. half circle, whole degrees, . .	.15
302.	Do. 5 do. do. half degrees, . .	.25
303.	Do. 6 do. do. do. . .	.30
304.	Do. 7 do. do. do. . .	.50
305.	Do 8 do. do. do. . .	.80
306.	Brass Protractor, 4 do. do. whole degrees, . .	.10
307.	Do. 4 do. do. half degrees, . .	.35
308.	Do. 5 do. do. do. . .	.55
309.	Do. 6 do. do. do. . .	.65
310.	German Silver Protractor, 4 inches diameter, half circle, whole degrees,	.50
311.	Do. do. 5 do. do. half degrees, .	.85
312.	Do. do. 6 do. do. do. .	1.00
313.	Do. do. 7 do. do. do. .	1.15
314.	Do. do. 5 do. do. bev. edge, half deg.,	1.25
315.	Do. do. 6 do. do. do. do.	2.00
316.	Do. do. 7 do. do. do. do.	2.65

PAPER PROTRACTORS.

320.	Whole Circle Protractors, 8 or 13 inches diameter, half degrees, on drawing paper, printed in red or black, each, ...	.30
321.	Same as No. 320, on Bristol boards, each, ...	.40
322.	Same as No. 320, on vegetable tracing paper, ...	.25
323.	Half Circle Protractor, 5 inches diameter, half degrees, on Bristol boards, each, ...	.25

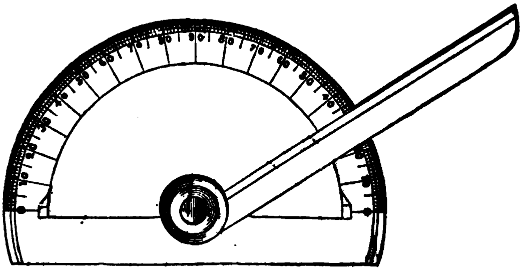
EXTRA FINE SWISS PROTRACTORS.



334.

No.		Price.
330.	Protractor, 4 inches diameter, ½ circle, whole degrees, centre on outer edge,	$1.50
331.	Do. 5 do. ½ do. ½ do. do. do.	2.00
332.	Do. 6 do. ½ do. ½ do. do. do.	3.00
333.	Do. 6 do. ½ do. ¼ do. do. do.	3.25
334.	Do. 5 do. ½ do. ½ do. do. inner edge,	2.50
335.	Do. 6 do. ½ do. ½ do. do. do.	3.00
336.	Do. 6 do. ½ do. ¼ do. do. do.	4.00

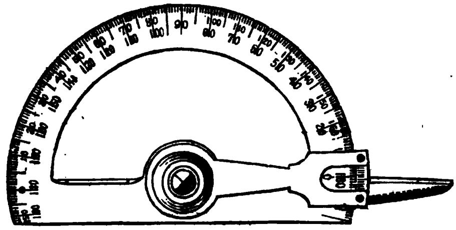
EXTRA FINE SWISS PROTRACTORS, OF GERMAN SILVER, WITH ARMS.



350.

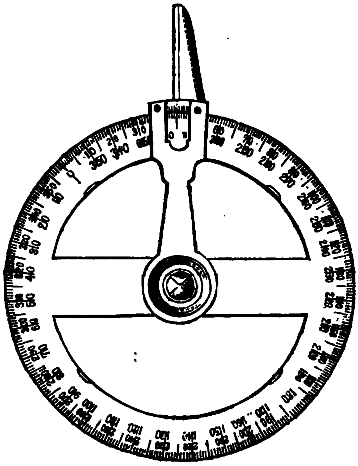
350.	German Silver Protractor, 5 inches diameter, half circle, with arm, and divided in half degrees,	7.50
351.	German Silver Protractor, 6 inches diameter, half circle, with arm, and divided in half degrees,	8.50
352.	German Silver Protractor, 7 inches diameter, half circle, with arm, and divided in half degrees,	9.00
354.	German Silver Protractor, 8 inches diameter, half circle, with arm, and divided in half degrees,	9.50
360.	German Silver Protractor, 5 inches diameter, whole circle, with arm, and divided in half degrees,	9,00
361.	German Silver Protractor, 6 inches diameter, whole circle, with arm, and divided in half degrees,	10.00
362.	German Silver Protractor, 7 inches diameter, whole circle, with arm, and divided in half degrees,	11.00
363.	German Silver Protractor, 8 inches diameter, whole circle, with arm, and divided in half degrees,	12.00

EXTRA FINE SWISS PROTRACTORS OF GERMAN SILVER, WITH ARMS AND VERNIERS.



370.

No.		Price.
370.	Protractor, 5½ inches diameter, half circle, half degrees, with vernier reading to three minutes, ...	$11.00
371.	Protractor, 8 inches diameter, half circle, quarter degrees, with vernier reading to one minute, ...	14.00
372.	Protractor, 10 inches diameter, half circle, quarter degrees, with vernier reading to one minute, ...	18.00

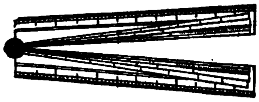


373.

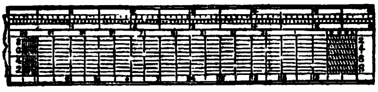
373.	Protractor, 5½ inches diameter, whole circle, half degrees, with vernier reading to three minutes, ...	14.50
374.	Protractor, 8 inches diameter, whole circle, quarter degrees, with vernier reading to one minute, ...	16.00
375.	Protractor, 10 inches diameter, whole circle, quarter degrees, with vernier reading to one minute, ...	20.00

CHAPTER VI.

SECTORS, SCALES, AND PROTRACTORS.

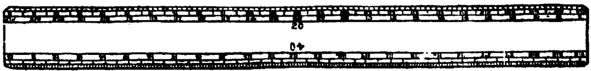


400.



401.

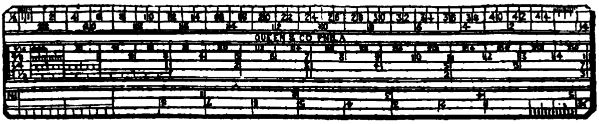
No.		Price.
400.	Ivory Sector, 6 inches long, opens to 12 inches long, ...	$2.25
401.	Ivory Scale, 6 inches long, for school drawing, ...	.75



402.

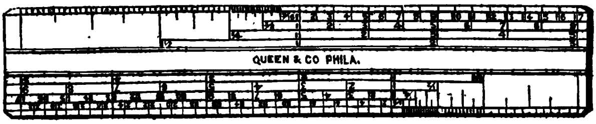
402.	Ivory Chain Scales, 12 inches long, graduated on two edges with either 10 and 10 parts, or 10 and 20, or 20 and 40, or 30 and 50, or 40 and 60, or 50 and 60, each, ...	3.00
403.	Do. do. do. with 40 and 80, or 50 and 100, each,	5.25
404.	Do. do. do. with 80 and 100, each, ...	5.75
405.	Ivory Off-set Scales, 2 inches long, 10 by 10, 10 by 20, 20 by 40, 30 by 50, 40 by 60, each, ...	.65

ARCHITECTS' IVORY SCALES.



406.

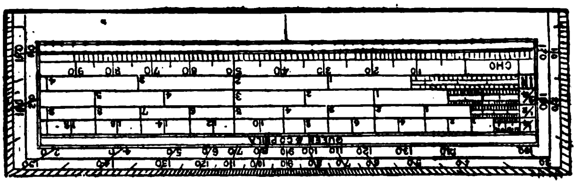
406.	Ivory Scale, 12 inches long, with 16 scales, as follows: $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, 1, $1\frac{1}{4}$, $1\frac{1}{2}$, $1\frac{3}{4}$, 2, $2\frac{1}{4}$. $2\frac{1}{2}$, and 3 inches to the foot, the first division of each scale subdivided in 12 parts, each, ...	3.00
407.	Same as No. 406, but with the first division of each scale subdivided into 10 parts, each, ...	3.00
408.	Ivory Scale, 12 inches long, with 12 scales, as follows: $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{5}{8}$, $\frac{7}{8}$, 1, $1\frac{1}{4}$, $1\frac{1}{2}$, $1\frac{3}{4}$, 2, and 3 inches to the foot, the first division of each scale subdivided into 12 parts, diagonal scale reading to $\frac{1}{100}$ and $\frac{1}{200}$ of an inch, each, ...	3.00
409.	Same as No. 408, but has the first division of each scale subdivided into 10 parts, each, ...	3.00



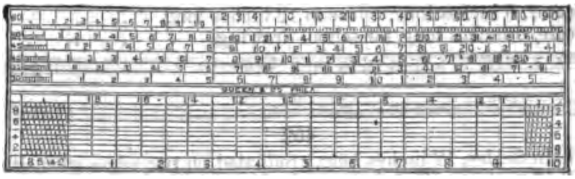
410.

410.	Ivory Scale, 12 inches long, one side rounded, the other flat, with the following scales, the graduations of which are all brought to the edge: $\frac{1}{16}$, $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, 1, $1\frac{1}{4}$, $1\frac{1}{2}$, $1\frac{3}{4}$, 2, $2\frac{1}{2}$, and 3 inches to the foot, the first division of each scale is subdivided into 12 parts, each, .	3.00
411.	Same as No. 410, but the first division of each scale subdivided into 10 parts, each, ...	3.00
412.	Flat Ivory Scale, 6 inch, div. $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1 inch to the foot, each, . .	2.00
413.	Do. do. 12 do. $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1 do. do. . .	3.25
414.	Do. do. 12 do. $\frac{3}{8}$, $\frac{3}{4}$, $1\frac{1}{2}$, 3 do. do. . .	3.25

IVORY PROTRACTORS.



425. FRONT SIDE.

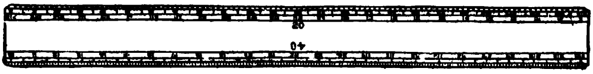


425. REVERSE SIDE.

No.		PRICE.
425.	Ivory Rectangular Protractor, 6 inches long, $1\frac{3}{4}$ inches wide, with scales as follows: front sides divided around edge from 0 to 180 degrees in single degrees, scales of $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, and 1 inch to the foot, and scale of chords. Reverse side scales of 30, 35, 40, 45, 50, and 60 parts to the inch, scale of chords and diagonal scale of inches and $\frac{1}{100}$ths, . .	$1.50
426.*	Ivory Rectangular Protractor, 6 inches long by $1\frac{3}{4}$ inches wide, with scales as follows: front side, the edge divided in single degrees from 0 to 180 degrees, scales of $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, and 1 inch to the foot, and scale of chords. On the reverse side, scales of 30, 35, 40, 45, 50, and 60 parts to the inch, scale of chords and diagonal scale of $\frac{1}{100}$ths, .	2.25
427.	Ivory Rectangular Protractor, 6 inches long by 2 inches wide, with scales as follows: front side, the edge divided in single degrees from 0 to 180 degrees, scales of $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, 1, $1\frac{1}{8}$, $1\frac{1}{4}$ inches to the foot, scale of chords, and line of 40 parts on lower edge. On the reverse side scales of 20, 25, 30, 35, 40, 45, 50, 60 parts to the inch, diagonal scale of $\frac{1}{100}$ths,	3.25
428.	Ivory Rectangular Protractor, same as No. 427, but has the Protractor divided in $\frac{1}{2}$ degrees, ...	4.00
429.	Ivory Rectangular Protractor, 6 inches long by $2\frac{1}{4}$ inches wide, with scales as follows: front size, the edge divided in $\frac{1}{2}$ degrees from 0 to 180 degrees, scales of $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, 1, $1\frac{1}{8}$, $1\frac{1}{4}$, $1\frac{3}{8}$, $1\frac{1}{2}$ inches to the foot, scale of chords, and scale of 40 parts on lower edge. Reverse side, scales of 10, 15, 20, 25, 30, 35, 40, 45, 50, 60 parts to the inch, and diagonal scale of $\frac{1}{100}$ths, ...	4.50
430.	Ivory Rectangular Protractor, 6 inches long by $2\frac{1}{2}$ inches wide, with scales as follows: front side, the edge divided in $\frac{1}{2}$ degrees from 0 to 180 degrees, scales of $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, 1, $1\frac{1}{8}$, $1\frac{1}{4}$, $1\frac{3}{8}$, $1\frac{1}{2}$ inches to the foot, scale of chords, and scale of 40 parts on lower edge. Reverse side, scales of 20, 25, 30, 35, 40, 45, 50 and 60 parts to the inch, 2 scales of chords, scales of latitudes, sines, tangents, hours, longitudes, secants, rhombs,	6.00
431.	Ivory Rectangular Protractor, 8 inches long by 2 inches wide, with scales as follows: front side, the edge divided in $\frac{1}{2}$ degrees from 0 to 180 degrees, scales of $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, 1 inch to the foot, scale of chords and scale of 40 parts on lower edge. Reverse side, scales of 30, 35, 40, 45, 50, 60 parts to the inch, scale of chords and diagonal scale of $\frac{1}{100}$ths,	5.00
432.	Ivory Rectangular Protractor, 12 inches long by $2\frac{1}{2}$ inches wide, with scales as follows: the edge divided in $\frac{1}{2}$ degrees from 0 to 180 degrees, scales of $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, 1, $1\frac{1}{8}$, $1\frac{1}{4}$, $1\frac{3}{8}$, $1\frac{1}{2}$, scale of chords and scale of 40 on lower edge. Reverse side, scales of 10, 15, 20, 25, 30, 35, 40, 45, 50, 60 parts to the inch, scale of chords and diagonal scale of $\frac{1}{100}$ths,	11.50

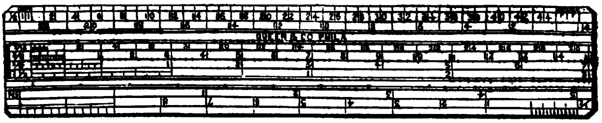
CHAPTER VII.

No.		Price.
450.	Boxwood Protractor, 6 inches long, 1¾ inches wide, whole degrees, with 6 scales of equal parts, 4 scales of feet and inches, 2 scales of chords, and diagonal scale, ...	$0.50
451.	Boxwood Scale, 6 inches long, for School Cases of Instruments, . .	.20



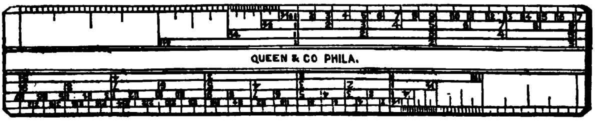
452.

452.	Boxwood Chain Scale, 12 inches long, graduated on two edges with either 10 and 10 parts, or with 10 and 20 parts, or with 20 and 40 parts, or with 30 and 50 parts, or with 40 and 60 parts, or with 50 and 60 parts, .	1.25
453.	Boxwood Off-set Scales, 2 inches long, graduated 10 by 10, 10 by 20, 20 by 40, 30 by 50, 40 by 60, each, ...	.25



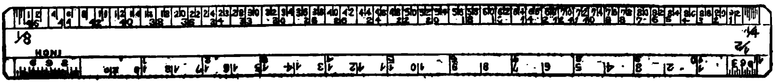
454.

454.	Boxwood Scale, 12 inches long, with 16 scales, as follows: ⅛, $\frac{3}{16}$, ¼, ⅜, ½, ⅝, ¾, ⅞, 1, 1¼, 1½, 1¾, 2, 2¼, 2½, and 3 inches to the foot, the first division of each scale subdivided in 12 parts, each, ...	1.25
455.	Same as No. 454, but with the first division of each scale subdivided into ten parts, each, ...	1.25
456.	Boxwood Scale, 12 inches long, with 12 scales, as follows: ⅛, $\frac{3}{16}$, ¼, ⅜, ⅝, ⅞, 1, 1¼, 1½, 1¾, 2, and 3 inches to the foot, the first division of each scale subdivided into 12 parts, and diagonal scale reading to $\frac{1}{100}$ths and $\frac{1}{200}$ths of an inch, each, ...	1.25
457.	Same as No. 456, but has the first division of each scale subdivided into 10 parts, each, ...	1.25

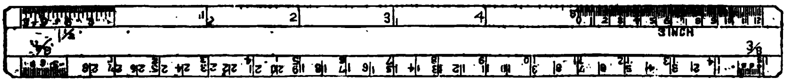


458.

458.	Boxwood Scale, 12 inches long, one side rounded, the other flat, with the following scales, the graduations of which are all brought to the edge: $\frac{1}{16}$, ⅛, $\frac{3}{16}$, ¼, ⅜, ½, ⅝, ¾, ⅞, 1, 1¼, 1½, 1¾, 2, 2½, and 3 inches to the foot, the first division of each scale subdivided into 12 parts, each, .	1.25
459.	Same as No. 458, but has the first division of each scale divided into 10 parts, each, ...	1.25

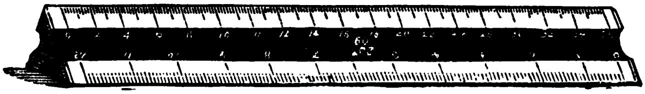


459 A.



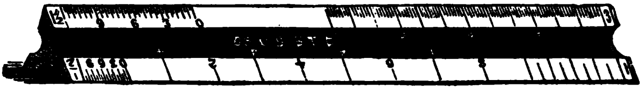
459 A.	Flat Boxwood Scale, 6 inch, div. ⅛, ¼, ½, 1 or ⅜, ¾, 1½, 3 inch to foot, each,	.75
459 B.	Do. do. 12 do. ⅛, ¼, ½, 1 or ⅜, ¾, 1½, 3 do. do.	1.25
459 C.	Do. do. 24 do. ⅛, ¼, ½, 1 or ⅜, ¾, 1½, 3 do. do.	2.50
459 D.	Flat Scale, 12 inch, beveled on both sides, graduated ⅛, ¼, ½, 1, and ⅜, ¾, 1½, 3 inches to the foot, each, ...	1.50

No.		Price.
460.	Triangular Scale of German Silver, silver plated, 12 inches long, graduated, ⅛, ¼, ⅜, ½, ¾, and 1 inch to the foot, each, ...	$6.00
461.	Triangular Scale of German Silver, silver-plated, 12 inches long, graduated 10, 20, 30, 40, 50, and 60 to the inch, each, ...	6.00



462.

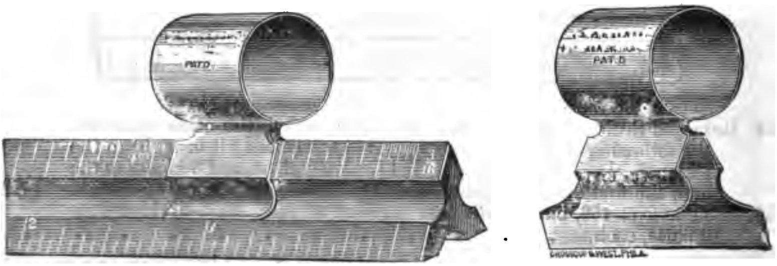
No.		Price.
462.	Triangular Scale of Boxwood, 24 inches long, graduated 10, 20, 30, 40, 50, and 60 to the inch; or, 20, 30, 40, 50, 60, and 80 to the inch, .	5.00
463.	Do. do. do. do. 12 inch,	2.00
463½.	Do. do. 12 inches long, graduated 100, 200, 300, 400, 500, 600 to the foot, each, ... -	2.00
464.	Do. do. 6 inches, graduated same as No. 462, . .	1.50
464½.	Triangular Scales of Boxwood for Off-sets, 2 inches long, 10, 20, 30, 40, 50, and 60 parts, ...	.75



465.

No.		Price.
465.	Triangular Scale of Boxwood, 24 inches long, graduated $\frac{3}{32}$, $\frac{3}{16}$, ⅛, ¼, ⅜, ½, ¾, 1, 1½, 3 inches and 16ths to the foot, ...	5.00
466.	Do. do. do. 12 inches long,	2.00
467.	Do. do. do. 6 do. .	1.50

Boxwood Triangular Scales, 6 *and* 12 *inches, put in strong paper boxes, and mailed to any address at an additional cost per scale of* 25 *cents.*



470.

No.		Price.
470.	Triangular Scale Guard, each, ...	.25
	A very useful attachment to the Triangular Scale, to obviate the liability to error, and the loss of time caused by the necessity of a careful examination of the scale each time it is used.	
471.	Gunter Scales, 12 inches, each, ...	.75
472.	Do. 24 do.	1.25
473.	Boxwood School Rule, 12 inches, ⅛ and $\frac{1}{16}$ inch, ...	.15
474.	Do. do. 12 do. ⅛ beveled brass edge, ...	.35
475.	Do. do. 18 do. do. do.	.50

STEEL DRAUGHTING SCALES.

No.		PRICE.
476.	Flat, Beveled Steel Scales, fully divided on four edges to ⅛, ¼, ½, and 1 inch to the foot, each,	$1.75
	Or divided to ⅜, ¾, 1½, and 3 inches to the foot,	1.75
477.	Same as above, but divided only on two edges, with scales of ⅛ and ¼ inch to the foot, each,	1.50
	Or ½ and 1 inch to the foot, each,	1.50
	Or ⅜ and ¾ inch to the foot, each,	1.50
	Or 1½ and 3 inches to the foot, each,	1.50
478.	Same as above, but beveled on both sides, graduated ⅛, ¼, ½, and 1, and ⅜, ¾, 1½, and 3 inches to the foot, each,	2.00

METRIC SCALES AND RULES.

	10	20	30	50 cm. long.
Flat Boxwood, fully divided.	$0.60	$0.90	$1.25	$1.75 each.
Ivory Flat,	2.25	4.00	5.00 each.	

Triangular Boxwood, 20	30 cm. long.
$1.50	$2.00

Metric Rule, boxwood, 1 meter, 6 fold, with springs at each joint,	.75
Metric Rule, boxwood, 1 meter, 4 fold, divided inches and meter, each,	.60
Same as above, but in ivory,	1.75
Same as above, but in ivory, ½ m. in length,	1.00
Engineer's Metric Rule, 4 foot, 8 fold, divided to inches and meters, each,	.75

PAPER SCALES.

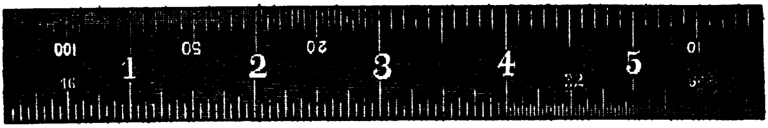
480.	Paper Scale, printed on card-paper, 1¼ inch wide, 12 inches long, graduations on one edge inches and 10ths, and the other feet and 100ths,	.10
481.	Paper Scale, same as 480, one edge 20 parts to the inch, the other edge 40,	.10
482.	Paper Scales, same as 481, one edge inches and sixteenths, the other edge inches and forty-eighths,	.10
483.	Paper Scale, printed on card-paper, 19 inches long, for architects and engineers, in sets of 6 scales, per set,	1.00
	Series A contains 6 scales, one each, divided to ¼, ½, ¾, 1, 1½, and 3 inches to the foot.	
	Series B contains 6 scales, one each, divided to $\frac{3}{32}$, ⅛, $\frac{3}{16}$, $\frac{5}{16}$, ⅜, and ⅞ inch to the foot.	
	Series C contains 6 scales, one each, divided to 10, 20, 30, 40, 50, and 60 parts to the inch.	
484.	Single Scale of any of the above series, A, B, C—each scale,	.20
485.	Paper Scales, same as 483, divided either to ⅝, 1⅛, 1¼, or 1⅜ inches to the foot, each,	.20

The advantages of these scales are, they expand and contract nearly the same as drawing-paper, do not soil the work, and distances can be set off from them without the use of dividers.

We manufacture to order Scales to any divisions, in ivory, boxwood, whitewood, or rubber.

CHAPTER VIII.

SQUARES, CALIPERS FOR MACHINISTS, STRAIGHT EDGES.

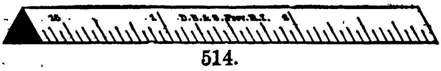


500.

No.		PRICE.
500.	24-inch Steel Rule, graduated to inches, 8ths, 10ths, 12ths, 16ths, 20ths, 24ths, 32ds, 48ths, 50ths, 64ths, and 100ths of an inch,	$4.00
501.	12 inches, do. do. do.	2.00
502.	9 do. do. do. do.	1.50
503.	6 do. do. do. do.	1.00
504.	4 do. do. do. do.	.75
505.	3 do. do. do. do.	.50
506.	Steel Rule and Scale, 12 inches long, divided in inches and 16ths on one side, and inches and 12ths or 10ths on the other,	.75
507.	Same as 506, but divided in inches and 16ths on one side, and inches, 8ths, 32ds, and 64ths on the other,	1.00
508.	Same as 506, but divided in inches and 16ths on one side, and centimeters and millimeters on other side,	1.25
509.	Steel Shrink Rule, 24$\frac{1}{4}$ inches long, graduated as No. 500,	4.50
510.	Boxwood Shrink Rule, 24$\frac{1}{4}$ inches long, graduated as No. 500,	3.00
511.	Steel Standard Yard Measure, graduated to inches and 8ths on one side, and on the other side to $\frac{1}{16}$, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, and $\frac{7}{8}$ of a yard,	3.00
512.	Steel Standard French Measures, subdivided to centimeters and millimeters. $\frac{1}{5}$ meter long, $1.75; $\frac{3}{10}$ do., $2.50; $\frac{1}{2}$ do., $4.00; 1 do.,	10.00

513.

513.	Square Steel Rules, divided to 8ths, 16ths, 32ds, 64ths, and 100 parts to the inch, ... 3 inches long, 50 cts.; 4 ins., 75 cts.; 6 ins.,	1.00



514.

514.	Triangular Steel Rules, 3 inches long, divided to 12, 16, 20, 24, 32, 48, 50, 64, and 100 parts to the inch,	0.60
	4 inch, 80 cts.; 6 inch, $1.20; 12 inch,	3.00
514$\frac{1}{2}$.	Centre Gauge, and Gauge for Grinding and Setting Screw Tools,	.50

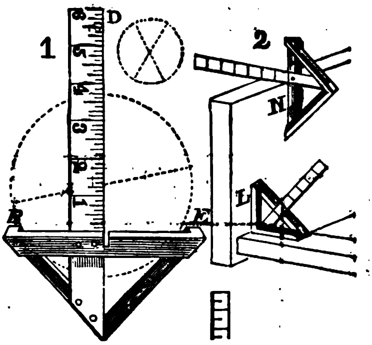
The angles used in this Gauge are 60 degrees. The four divisions upon the Gauge of 14, 20, 24, and 32 parts to the inch, are very useful in measuring the number of threads to the inch of taps and screws. The following parts to the inch can be determined by them, viz.: 2, 3, 4, 5, 6, 7, 8, 10, 12, 14, 16, 20, 24, and 32.

☞ *Any of the above Scales nickel-plated for five cents per running inch.*

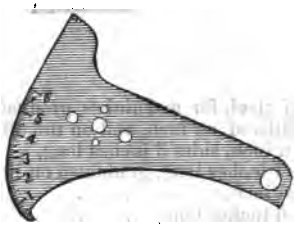
AMES' PATENT UNIVERSAL SQUARE.

This square combines, in a most convenient form, *five different instruments*, viz., The TRY-SQUARE, the MITER, the T-SQUARE, the GRADUATED RULE, and (what is entirely new) the CENTRE SQUARE, for finding the centre of a circle.

Fig. 1 explains its application as a CENTRE-SQUARE. Put the instrument over the circle, as the end of the bolt or shaft, with the arms B A, A E resting against the circumference, in which position one edge of the rule, A D, will cross the centre. Mark a straight line in this position; apply the instrument again to another part of the circumference, and mark another line crossing the first. The point where the two lines cross each other will be the centre of the circle. The whole is the work of a moment. *Fig.* 2 explains the application of the instrument as a carpenter's TRY-SQUARE, N, and an OUTSIDE SQUARE.



No.				Price.
515.	Ames' Patent Universal Square, blade	6	inches long,	$3.00
516.	Do. do.	8	do.	4.00
517.	Do. do.	10	do.	5.50
518.	Do. do.	12	do.	7.00



518½.

Robinson's New Templet Odontograph is a ready-made Scribe Templet of universal application for describing Teeth of Gear Wheels.

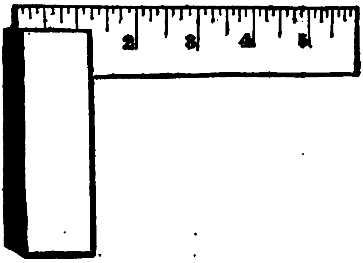
Price, in morocco case, with Rules and Tables,	3.00
Treatise on the above Odontograph, by Prof. S. W. Robinson,	.50

WILLIS' ODONTOGRAPH.

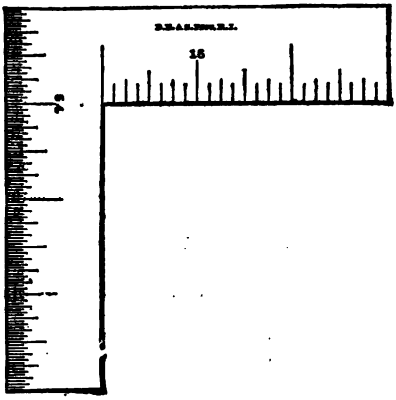
This is an instrument recently invented by Prof. R. Willis, of Cambridge University, England, for describing the correct form of the teeth of wheels, and the templets and cutters used in making them. All wheels of the same pitch, but of different sizes, having their teeth drawn with this instrument, will run together correctly.

519.	Willis' Odontograph, for drawing the teeth of small wheels by diametrical pitch, when only a single arc is required, with drawing and direction for use,	2.50
520.	Willis' Odontograph, for drawing the teeth of larger wheels by circular pitch, where it is necessary to have separate arcs for flanks and faces, with drawing and direction for use,	4.00
520½.	Willis' Odontograph, on Bristol-board, revised by Prof. W. D. Marks, University of Pennsylvania, giving additional tables, explanation, and formula, making it of universal application,	.75

No.		PRICE.
521.	Heavy-headed Square, made of hardened steel, for machinists, graduated to inches and 32ds of an inch, blade 3 inches long, . . .	$2.50
522.	Do. do. do. 4 do. . . .	3.00
523.	Do. do. do. 6 do. . . .	4.00
524.	Do. do. do. 9 do. . . .	7.00
525.	Do. do. do. 12 do. . . .	8.00



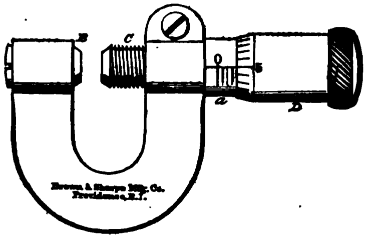
521.



526.

526.	Light Squares, made of steel, for machinists, graduated on one side to inches, 16ths, and 64ths of an inch, and on the other side to inches, 32ds, and 64ths of an inch, sides 3 inches long, ...	2.50
528.	Same as No. 526, sides 4 inches long, graduated on both sides to inches, 16ths, and 32ds of an inch, ...	3.00
529.	Same as No. 527, sides 6 inches long, ...	4.00

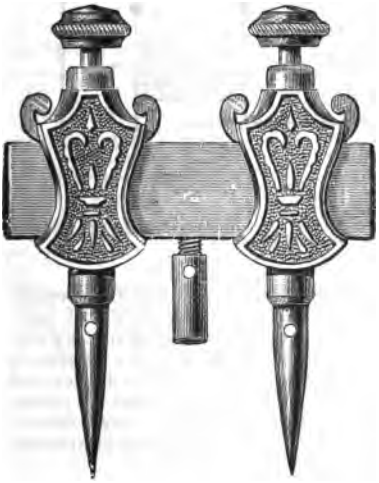
Any of the above Squares nickel-plated for five cents per inch of blade.



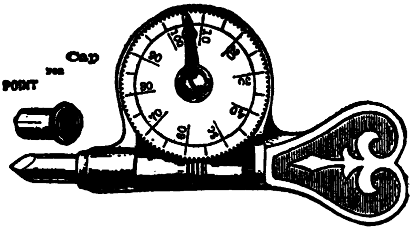
530.	Micrometer Caliper for Machinists' use, in morocco case, ...	6.50
530.	Do. do. do. without case, . . .	6.00

This is the most convenient form of Pocket Vernier Caliper; it can be used for all diameters less than one inch, and with the vernier reads to 1000ths of an inch.

IMPROVED TRAMMEL POINTS.



532.

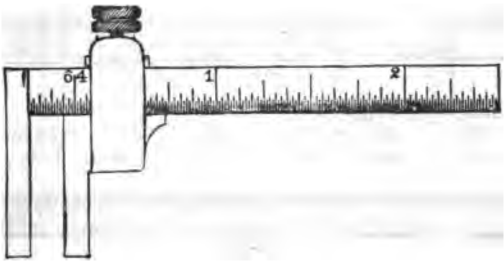


534.

These tools are used by all machinists and mechanics who have occasion to strike arcs or circles larger than can be done by compass dividers. They may be used on a straight wooden bar of any length, and when secured in position by the thumbscrews, all circular work can be readily laid out. They are made of bronze, and have steel points, either of which can be renewed, and replaced by pencil socket, which accompanies each pair.

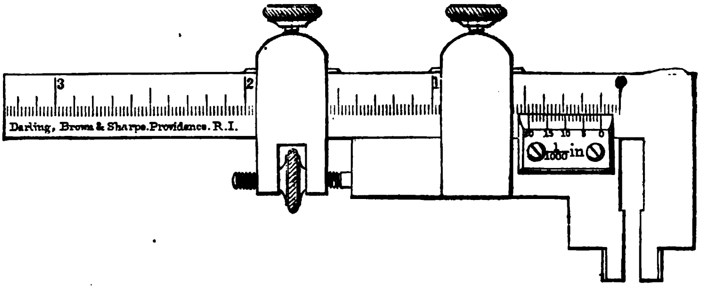
No.		PRICE.
531.	Small (No. 1), per pair,	$1.50
532.	Medium (No. 2), per pair,	2.00
533.	Large (No. 3), per pair,	2.75
534.	Speed Indicator,	2.00

STEEL CALIPERS.



535.

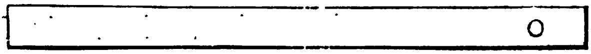
535.	Plain Steel Caliper, 2 inches long, graduated to 64ths of an inch,	4.00
536.	Do. do. 3 do. divided to 64ths of an inch,	5.00



These instruments can be furnished with millimeters (in the place of sixty-fourths of an inch), and provided with a vernier to read to one-fiftieth of a millimeter.

The cut is a fac-simile of one side of our hardened cast-steel Improved Vernier Caliper, a light, convenient, and valuable instrument for machinists' and toolmakers' use in obtaining correct measurements. The side represented above is graduated upon the bar to inches and fiftieths of an inch, and by the aid of a vernier is read to one-thousandths of an inch. The opposite side is graduated to inches and sixty-fourths of an inch. The outside of the jaws are of suitable form for taking inside measurements, and when the jaws are closed measure 250 one-thousandths of an inch in diameter. This Caliper will measure one inch and eleven-sixteenths, outside diameter, when the jaws are opened full size.

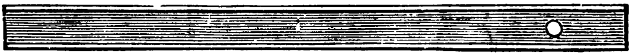
No.		Price.
537.	Vernier Steel Caliper, as shown above, in morocco case,	$12.50
539.	Pearwood Ovals, 2 to 6 inches long, 10 in a set, per set,	2 00
540.	Do. 1½ to 4½ do. 6 do. do.	1.50
541.	Do. ¾ to 7 do. 43 do. do.	5.00
542.	Pearwood Hyperbolas, 2 to 5 inches long, 8 in a set,	1.40
543.	Do. Parabolas, 12 do.	3 00
544.	Do. do. 1½ to 6 inches long, 8 do.	1.40



545.

545. Whitewood, beveled edge, thick,

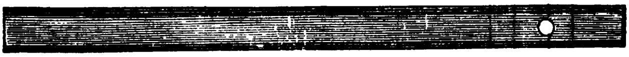
	12	18	24	30	36	42 inch.
each,	$0.15	.20	.25	.30	.40	.50.



546.

546. Hardwood lined, square edges, thin:

	24	30	36	42	48	54 inch.
each,	$0.40	.50	.70	.85	1.15	1.50.



547.

547. Mahogany, ebony lined, square edges, thin:

	24	30	36	42	48	54 inch.
each,	$0.55	.70	1.00	1 25	1.60	2.00.

548.

No.

548. Hard Rubber Rulers.

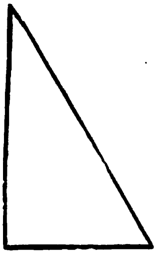
	12	18	24	30	36	42 inch.
each,	$0.50	.70	1.00	1.50	2.00	2.50

549. Steel, with one edge beveled, the other square.

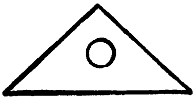
	18	24	30	36	42	48	60	72 inches long.
each,	$1.50	2.75	3.50	4.50	5.25	6.00	9.00	11.50

550. Steel, one edge beveled, the other square, nickel-plated.

	18	24	30	36	42	48	60	72 inches long.
each,	$1.75	3.00	4.00	5.00	6.00	8.00	10 50	14.00

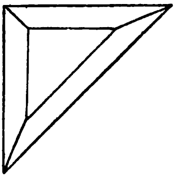


560.



561.

562.



563.

560. Pearwood Triangles, 30°x60°x90°.

5 or 6½	8 or 9½	11 or 12 inches long.
10 cents.	15 cents.	20 cents.

561. Pearwood Triangles, 45°x45°x90°.

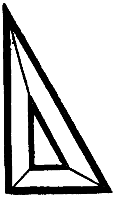
4, 5, or 6 inch,	7 or 8 inches long.
15 cents.	20 cents.

562. Pearwood or Cherry Triangles, framed open centre, 30°x60°x90°.

5	7	9	12	14	16	19 inches long.
$0.20	.25	.25	.30	.40	.75	1.00

563. Pearwood or Cherry Triangles, framed open centre, 45°x45°x90°.

5	6½	8	10	12	14 inches long.
$0.20	.25	.30	.40	.60	.75



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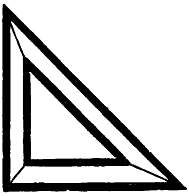
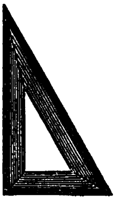
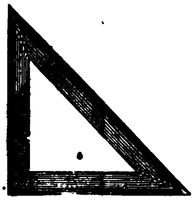


565.



564.



565.

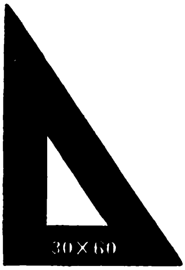
564. Mahogany or Walnut Triangles, ebony or maple lined, framed open centre, 30°x60°x90°.

5	6	7	9	11	13	15	18 inches long.
$0.50	.60	.70	.80	1.00	1.25	1.75	

565. Mahogany or Walnut Triangles, ebony or maple lined, framed open centre, 45°x45°x90°.

5	6	7½	9	11	13	15 inches long.
$0.50	.60	.70	.80	1.00	1.25	1.75

600.

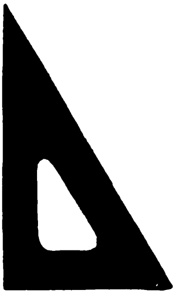


600.

No.

600. Hard Rubber Triangles, angles 30x60x90, or 22½x67½ degrees, either solid or with open centre.

Perpendiculars,	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	ins.
	$0.25	.25	.30	.35	.40	.55	.60	.65	.75	.95	1.10	1.25	1.50	1.75	2.00	each.



601.

601. Hard Rubber Triangles, angles 30x60x90 degrees, extra heavy, open centre.

Isosceles sides,	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	ins.
	$0.35	.40	.45	.50	.60	.70	.80	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	each.

603.

603. Hard Rubber Triangles, angles 45x45x90 degrees, either solid or with open centre.

Isosceles sides,	3	4	5	6	7	8	9	10	11	12	13	14	ins.
	$0.30	.30	.40	.50	.60	.70	.85	1.10	1.25	1.35	1.50	1.65	each.

604.

No. PRICE.

604. Hard Rubber Triangles, angles 45x45x90 degrees, extra heavy, open centre.

Isosceles sides,	5	6	7	8	9	10	11	12	13	14	15	16	17	18 ins.
	$0.50	.60	.70	.80	1.00	1.25	1.50	1 75	2.00	2.25	2.50	2.75	3.50	3.75 each.

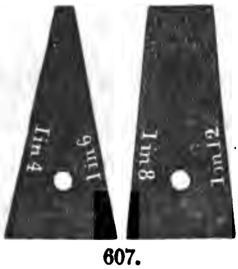
CROSS SECTION TRIANGLES.

606.

606. Cross Section Triangles, set of seven Cross Section Triangles, made of hard rubber, as follows, ¼ to 1, ½ to 1, ¾ to 1, 1 to 1, 1¼ to 1, 1½ to 1, 2 to 1, per set, ... $4.25

Single Triangles, each, ...75

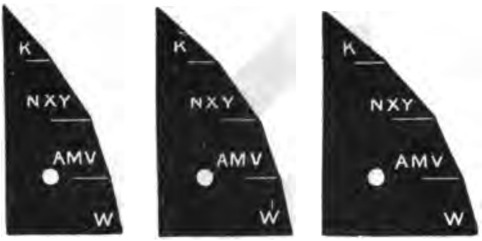
BATTER SLOPES.



607.

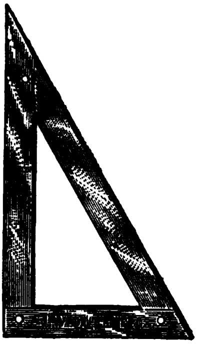
607. Set of three forms of hard rubber for Batters of walls and rock, giving the following slopes, 1 in 4, 1 in 5, 1 in 6, 1 in 8, 1 in 10, 1 in 12, per set, ... 2.00

Single Triangles, each, ...75



609.

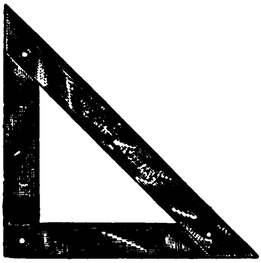
No.		Price.
609.	Hard Rubber Lettering Triangles, three in set, 3½ inches, per set,	$1.25
	Single templets,	.50



610.

610.	German Silver Triangle, angles 30, 60, and 90 degrees, perpendicular, 6 inches long, each,	2.50
611.	German Silver Triangle, angles 30, 60, and 90 degrees, perpendicular, 7 inches long, each,	2.75
612.	German Silver Triangle, angles 30, 60, and 90 degrees, perpendicular, 8 inches long, each,	3.00
613.	German Silver Triangle, angles 30, 60, and 90 degrees, perpendicular, 9 inches long, each,	3.50
614.	German Silver Triangle, angles 30, 60, and 90 degrees, perpendicular, 10 inches long, each,	4.00
615.	German Silver Triangle, angles 30, 60, and 90 degrees, perpendicular, 11 inches long, each,	5.00
616.	German Silver Triangle, angles 30, 60, and 90 degrees, perpendicular, 12 inches long, each,	5.50

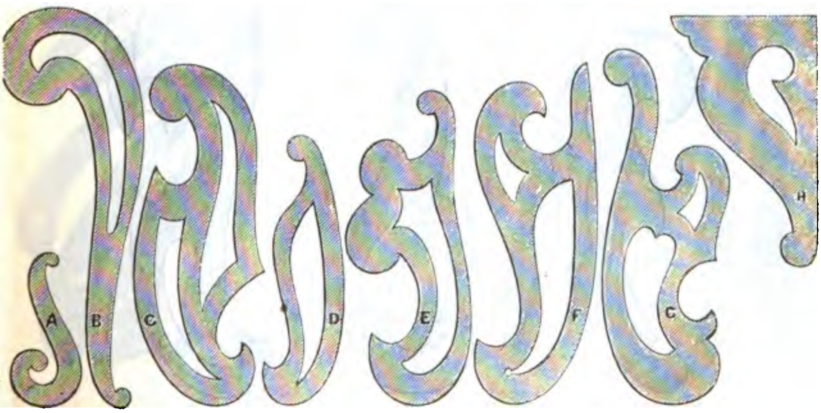
No.		Price.
617.	German Silver Triangle, angles 30, 60, and 90 degrees, perpendicular, 14 inches long, each,	$6.00
618.	German Silver Triangle, angles 30, 60, and 90 degrees, perpendicular, 15 inches long, each,	6.50



619.

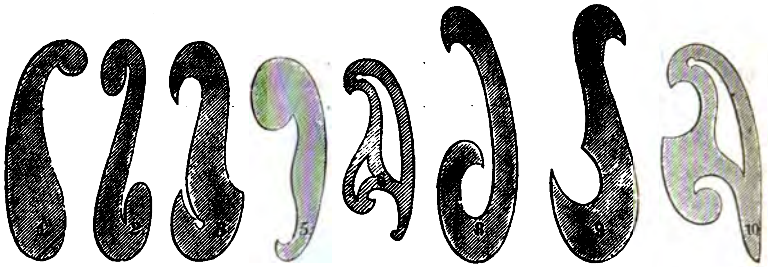
619.	German Silver Triangle, angles 45, 45, and 90 degrees, isosceles sides, 4 inches long,	2.00
620.	German Silver Triangle, angles 45, 45, and 90 degrees, isosceles sides, 5 inches long,	2.25
621.	German Silver Triangle, angles 45, 45, and 90 degrees, isosceles sides, 6 inches long,	2.75
622.	German Silver Triangle, angles 45, 45, and 90 degrees, isosceles sides, 7 inches long,	3.50
623.	German Silver Triangle, angles 45, 45, and 90 degrees, isosceles sides, 8 inches long,	4.00
624.	German Silver Triangle, angles 45, 45, and 90 degrees, isosceles sides, 9 inches long,	4.50
625.	German Silver Triangle, angles 45, 45, and 90 degrees, isosceles sides, 10 inches long,	5.00

IRREGULAR CURVES.



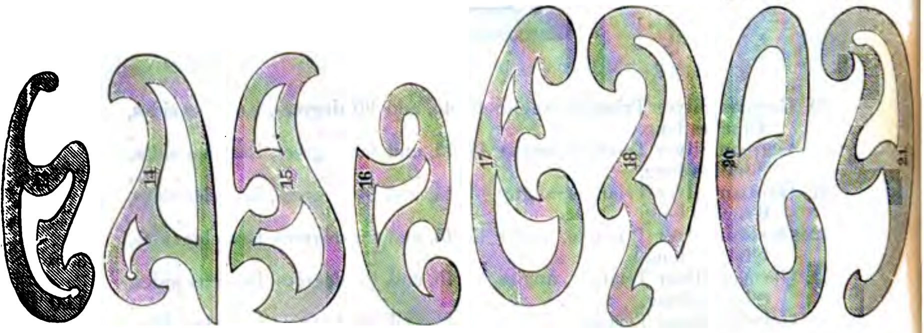
649.

649.	Whitewood Irregular Curves, 5 to 15 inches long, various patterns, each,	.20



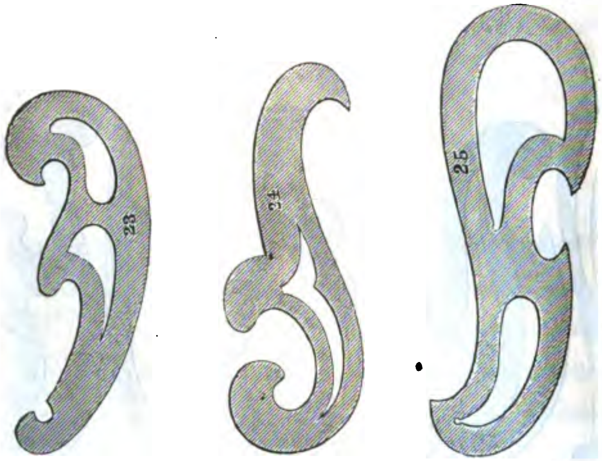
650.

No.		Price.
650.	Whitewood Irregular Curves, of superior quality, Nos. 1 to 6, each, .	$0.15
650½.	Hard Rubber do. do. Nos. 1 to 6, each, 35 cts.; Nos. 8 to 10, each,	.50



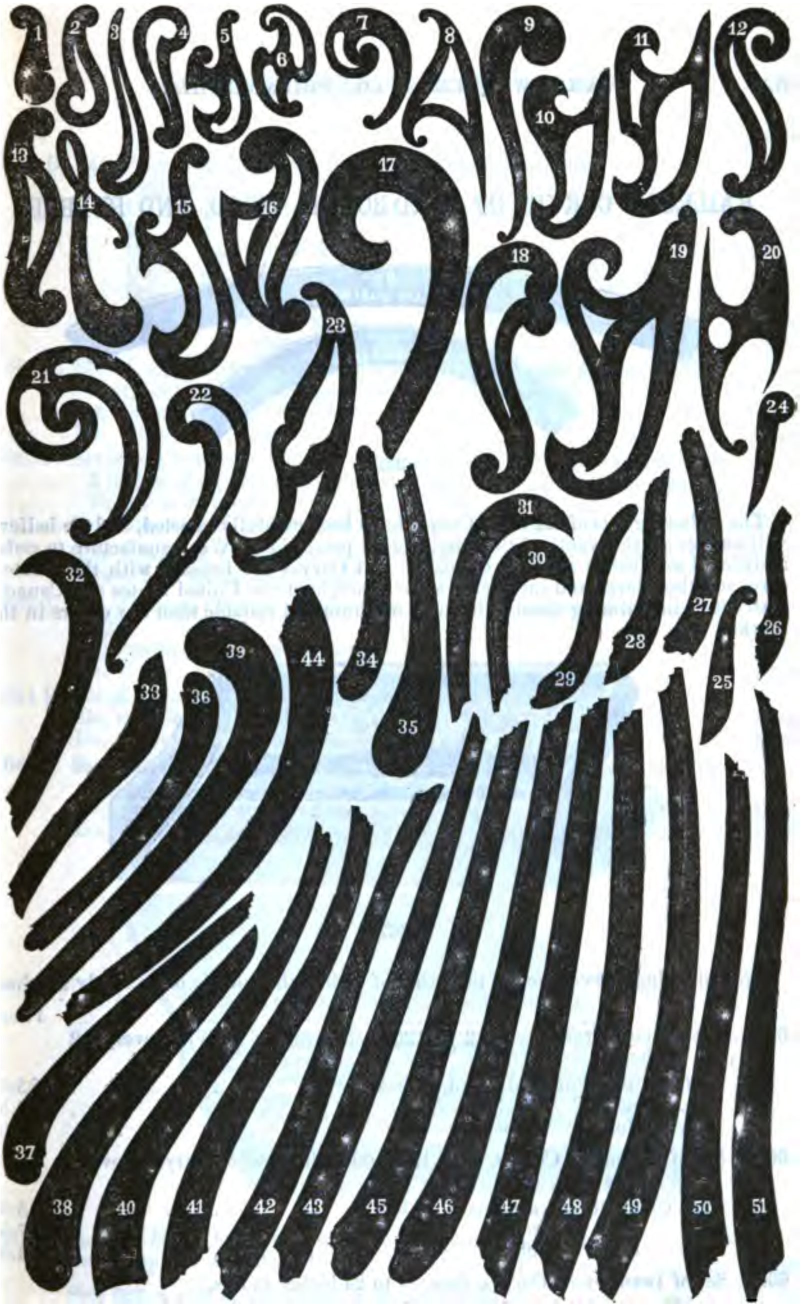
651.

651½.	Whitewood Irregular Curves, of superior quality, Nos. 13 to 21, each,	.2
651½.	Hard Rubber do. do. Nos. 13 to 21, each, ...	.75



652.

652.	Whitewood Irregular Curves, of superior quality, Nos. 23 to 25, each,	.55
652½.	Hard Rubber do. do. Nos. 23 and 24, each, $1; No. 25, each,	1.00

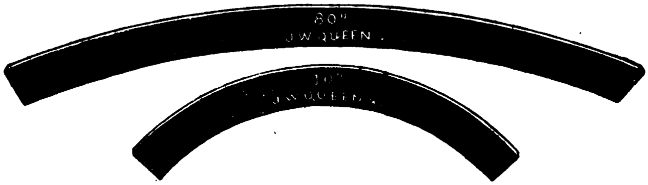


653.

No.		Price
653.	Hard Rubber and Irregular Ship Curves, 4 to 26 inches long, as used in the United States Navy Yards, complete set in wooden box, .	$38.50
654.	Single Curves of set No. 653.	

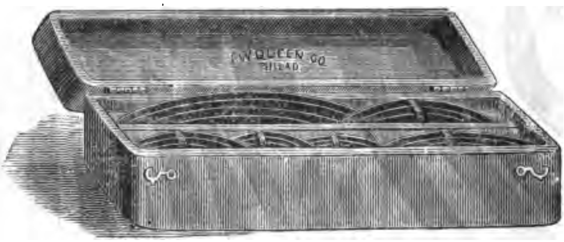
No. 1, 25 cents each; 2, 3, 45 cents; 4, 5, 6, 50 cents; 7, 8, 9, 10, 60 cents; 11, 12, 13, 14, 65 cents; 15, 75 cents; 16, 17, 18, 90 cents; 19, $1.10; 20, 21, 22, 23, $1.00; 24, 25, 35 cents; 26, 27, 28, 29, 30, 45 cents; 31, 32, 70 cents; 33, 34, 60 cents; 35, 36, 37, 70 cents; 38, 39, 40, 41, 42, 90 cents; 43, 44, 45, 46, 47, 48, 49, 50, 51, $1.10.

RAILROAD CURVES OF CARD-BOARD, WOOD, AND RUBBER.



665½.

The following sets of Railroad Curves have been carefully selected, and we believe will answer all the wants of the Engineering profession. We manufacture to order additional sets, cut to any desired scale. Our Curves are finished with the greatest care, and their large and increasing scale throughout the United States and Canada, warrant us in claiming them to be more accurate and reliable than any others in the market.



667½.

The following Curves are cut to a scale of inches, the outside of arcs only finished.

No.		PRICE.
660A.	Set of ten Curves, from 12 to 120 inches radius, varying every 12 inches:	
	Set, complete, of card-board, in box,	$3.00
	Do. do. wood, do.	4.50
	Do. do. rubber, do.	8.00
660B.	Set of seventeen Curves, from 12 to 60 inches radius, varying every 3 inches:	
	Set, complete, of card-board, in box,	5 00
	Do. do. wood, do.	7.50
	Do. do. rubber, do.	14.00
660C.	Set of twenty-four Curves, from 1½ to 24 inches radius, Varying ½″ from 1½″ to 10″, Do. 2″ from 10″ to 24″,	
	Set, complete, of card-board, in box,	7.50
	Do. do. wood, do.	10.00
	Do. do. rubber, do.	17.00

No. Price.

660 D. Set of forty-three Curves, from 3½ to 200 inches radius,
Varying every ½″ to 10″.
Do. do. 2″ to 24″.
Do. do. 3″ to 42″.
Do. do. 6″ to 90″.
Do. do. 10″ to 140″.
Do. do. 20″ to 200″.
Set, complete, of wood, in box, ... $16.00
Do. do. rubber, do. 27.50

660 E. Set of one hundred Curves, from 2 to 100 inches radius, varying every inch, with inside and outside of arcs finished:
Set, complete, of wood, in box, ... 46.00
Do. do. rubber, do. 70.00

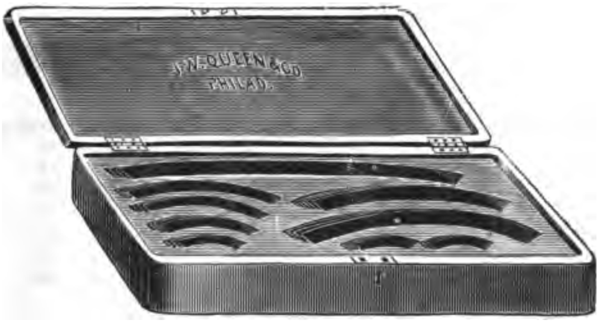
660 F. Set of one hundred and two Curves, from 3 to 200 inches radius, with 3 inches of tangent to each curve. Length of Curves, with tangent, from 7 to 21 inches:
Set, complete, of rubber, in box, ... 100.00

The following Curves are cut to a scale of 50 feet to the inch, and have both inside and outside of arcs finished:

661 A. Set of fifteen Curves, rising every 3′ to 3°, then single degrees to 12°:
Set, complete, of wood, in box, ... 7.50
Do. do. rubber, do. 12.00

661 B. Set of twenty Curves, rising every 30′ to 10°:
Set, complete, of wood, in box, ... 12.00
Do. do. rubber, do. 16.00

661 C. Set of fifty Curves, from 25′ to 3° by every 5′, and from 3° to 5° by every 15′, 5° to 10° by every 30′:
Set, complete, of wood, in box, ... 25.00
Do. do. rubber, do. 35.00



661 D. Same as 661 C, but with 3 inches of tangent to each Curve:
Set, complete, of rubber, in box, ... 50.00

Sets 662 A and B are cut to a scale of 100 feet to the inch, and have both inside and outside of arcs finished.

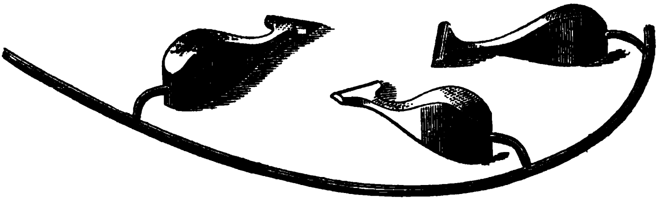
662 A. Set of twenty-four Curves, from 30′ to 12° by 30′:
Set, complete, of wood, in case, ... 14.50
Do. do. rubber, do. 19.00

No.		Price.
662 B.	Set of seventy Curves, from 15″ to 4° by every 5″, 4° to 10° by every 15″:	
	Set, complete, of wood, in case,	$38.00
	Do. do. rubber, do.	56.00
	Sets 663 A and B are cut to a scale of 400 feet to the inch, and are finished only on outside of arc.	
633 A.	Set of twenty Curves, from 30″ to 10° by every 30″:	
	Set, complete, of wood, in case,	9.00
	Do. do. rubber, do.	13.00
663 B.	Set of seventy Curves, from 15″ to 4° by every 5″, and from 4° to 10° by every 15″:	
	Set, complete, of wood, in case,	30.00
	Do. do. rubber, do.	46.00
668.	Railroad Curve Protractor, of horn, 8 inches diameter, having laid off on it 33 curves, from ½° to 8°, with a radii of 400 feet to the inch, each,	2.00

SHIP CURVES.

No.		Price.
668½.	Ship Curves, of pearwood, set of 10 curves, per set,	$5.50
669.	Hard Rubber, 28 in set, being Nos. 23 to 51, inclusive, as described in No. 654; set complete in box,	20 00
669½.	Same as above, but in wood,	11 00

These curves were made by us from drawings furnished by the chief draughtsman in the Navy Yard at League Island, and are the standard patterns as used in the United States.



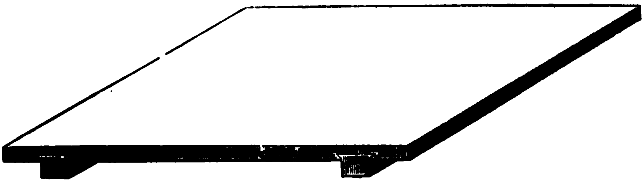
672.

670. Hard Rubber Splines.

	12	18	24	30	36	42 inch.
each,	$0.25	.30	.35	.40	.45	.50

671.	Pearwood Splines, 12 to 36 inches long, from	.15 to .30
672.	Lead Weights for Splines, each,	1.50
673.	Lead Paper Weights, covered with leather, each,	1.00
674.	Iron Paper Weights, round with knob small, each,	.60
675.	Do. do. square with knob, large, each,	1.00

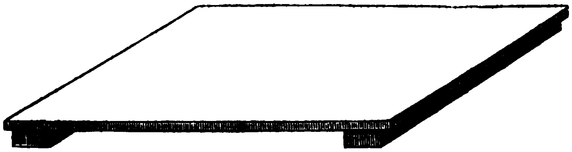
DRAWING BOARDS.



677.

677. Drawing Board, of pinewood, well seasoned, dove-tailed, hardwood batten,

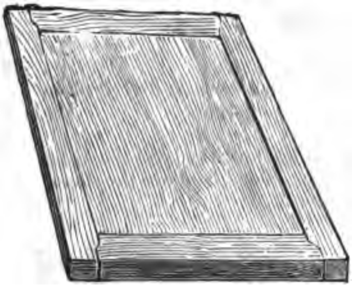
Do.	do.	cap size, 12 by 17 inches, each,	.75
Do.	do.	demy size, 16 by 21 inches, each,	1.15
Do.	do.	superroyal size, 20 by 28 inches, each,	1.50
Do.	do.	imperial size, 23 by 31 inches, each,	2.50
Do.	do.	atlas size, 27 by 34 inches, each,	2.50
Do.	do.	double elephant size, 28 by 42 inches, each,	2.75
Do.	do.	antiquarian size, 33 by 54 inches,	5.00



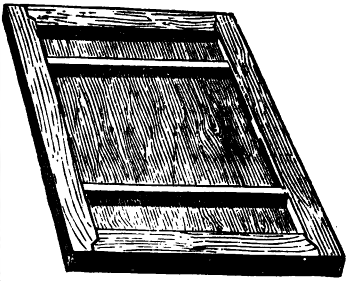
678.

678. Drawing Board, pinewood, hardwood battens screwed to the back. The screws run in slots, to allow free contraction or expansion.

Do.	do.	demy size, 16 by 21 inches, each,	1.50
Do.	do.	royal size, 20 by 26 inches, each,	2.25
Do.	do.	imperial size, 23 by 31 inches, each,	3.50
Do.	do.	double elephant, 28 by 42 inches, each,	5.50

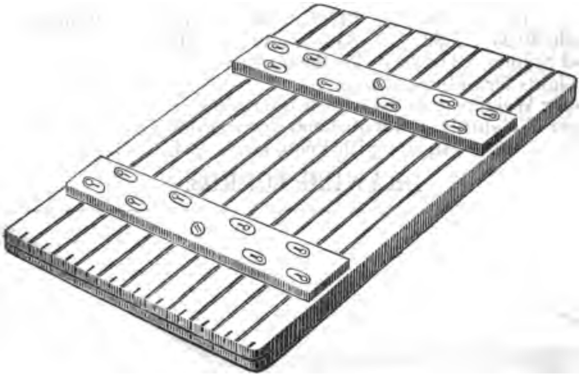


679.



679.

No.				Price.
679.	Walnut-framed Drawing Board,	centre of pine and removable.		
	Do.	do.	half royal size, 10½ by 17 inches, .	$2.00
	Do.	do.	half imperial size, 14 by 19 inches, .	2.50
	Do.	do.	royal size, 17 by 22 inches, . .	3.50
	Do.	do.	imperial size, 19 by 28 inches, . .	4.50
	Do.	do.	double elephant size, 24 by 38 inches,	7.00



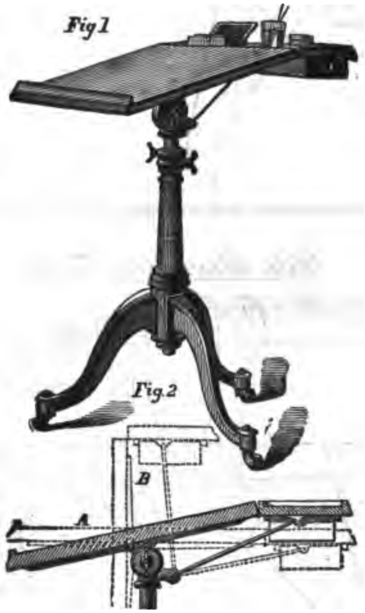
680.

680. Drawing Board,		pinewood, hardwood battens.	
Do.	do.	demy size, 15 by 21 inches, ...	3.00
Do.	do.	royal size, 20 by 26 inches, ...	4.50
Do.	do.	imperial size, 23 by 31 inches, ...	6.00
Do.	do.	double elephant size, 31 by 42 inches, ...	8.50
Do.	do.	antiquarian size, 33 by 55 inches, ...	12.00

The Drawing Board above illustrated is the best, and deserves recommendation, as it is the only one which possesses the qualities a good and true board should have. It is made of pinewood, glued up to the required width, with the heart side of each piece of wood to the surface. A pair of hardwood battens are screwed to the back, the screws pass through the ledges in oblong slots, bushed with brass, which fits closely under the heads, and yet allows the screws to move freely when drawn by the contraction of the board. To give the battens power to resist the tendency of the surface to warp, a series of grooves are sunk in half the thickness of the board over the entire back. These grooves take the transverse strength out of the wood to allow it to be controlled by the battens, leaving at the same time the longitudinal strength of the wood nearly unimpaired.

To make the two working edges perfectly smooth, allowing an easy movement with the square, a slip of hardwood is let into the end of the board. The slip is afterward sawn apart at about every inch to admit contraction.

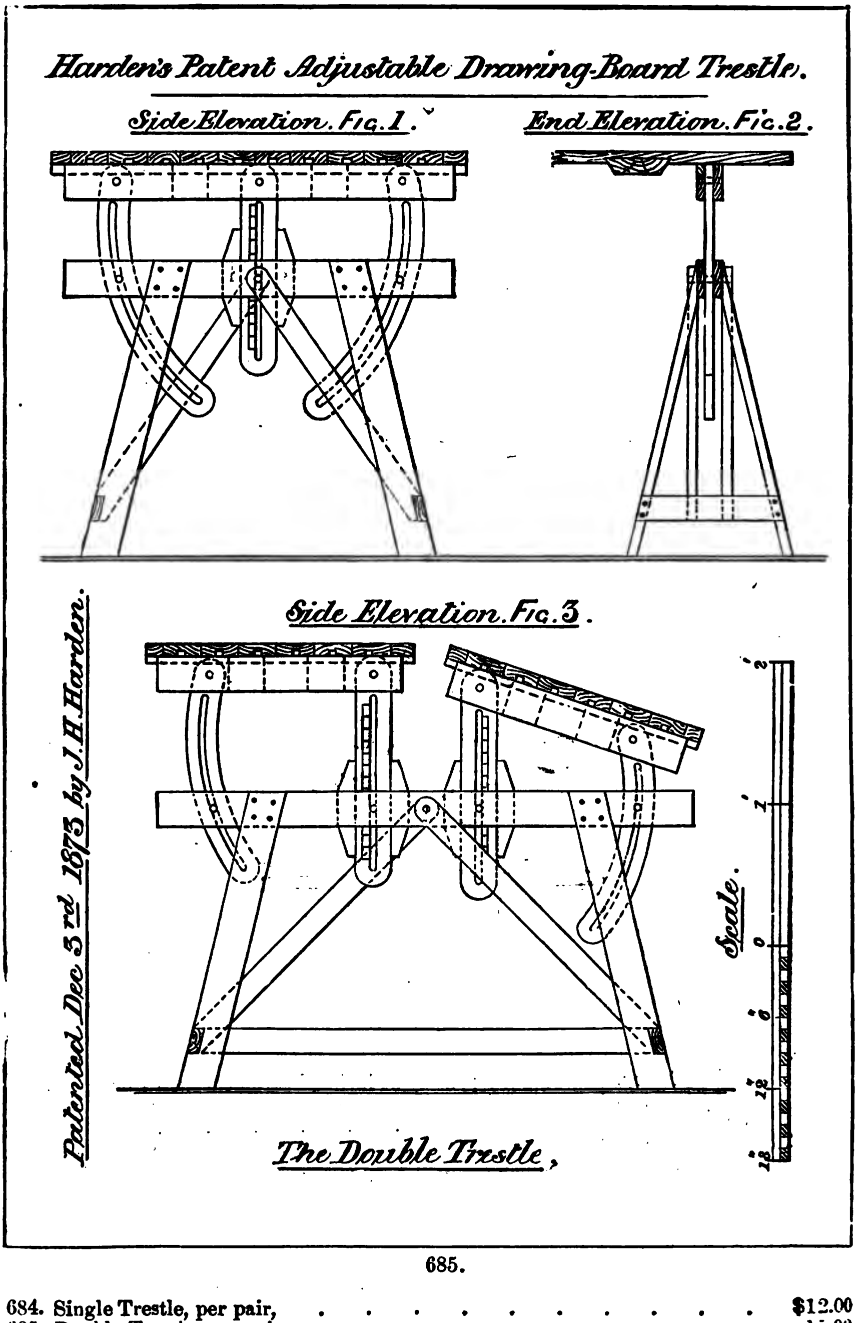
DRAWING TABLES.



681.

No.		Price.
681.	Drawing Table, black walnut top, 22 by 26 inches, instrument shelf 7 by 26 inches, two instrument drawers, ornamented iron stand mounted on castors, each, ...	$12.50
682.	Similar to No. 678, top of selected, polished walnut, iron stand, bronzed and tastefully ornamented, ...	15.50

684.



685.

684. Single Trestle, per pair, ...	$12.00
685. Double Trestle, per pair, ...	15.00

HARDEN'S PATENT ADJUSTABLE DRAWING-BOARD TRESTLE.

This invention consists in the application of curved and straight Slot Links, Thumb-screws, and an additional Bearing-bar to trestles of the ordinary form, by which means adjustment to the height of the Draughtsman is obtained, sitting or standing, from the height of a table to the full height of a drawing board, from the horizontal to any required angle of inclination on either side.

Figures 1 and 2 show side and end elevations of Trestle, suitable for the Artist, Engineer, or Architect's office.

Figure 3 shows the side elevation of a Double Trestle for the use of Mechanics, Schools, and Colleges, or where it may be desirable to economize space.

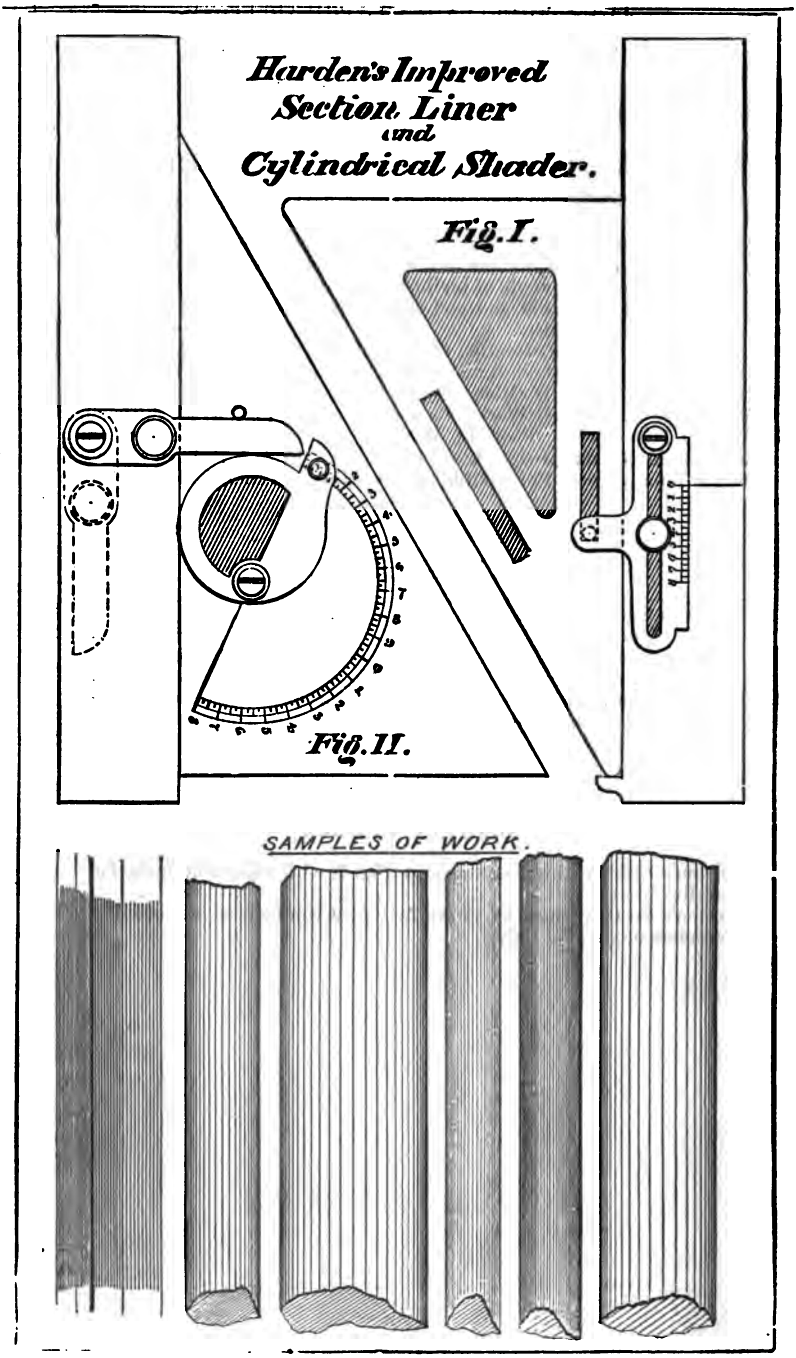
References.—Prof. T. W. Richards, Architect, 3332 Chestnut St., Philadelphia; F. Brotherhood, Taylor Iron Works, Charleston, S. C.; Prof. J. M. Silliman, Lafayette College, Easton, Pa.; Prof. L. M. Haupt, University of Pennsylvania, West Philadelphia; E. B. Coxe, Jeddo, Luzerne Co., Pa.; Prof. J. P. Lesley, State Geologist, 1008 Clinton Street, Philadelphia; Franklin Institute Exhibition (diploma awarded).

DRAWING MODELS.

	Price.
1 set Schröder's Simple Solids, 12 pieces,	$5.00
1 Do. do. do. do. 40 do.	20.00
1 Do. do. complete, 118 do. all mounted, so as to revolve on their axis, very complete,	175.00
683. New American Drawing Models, a set of 27 pieces, consisting of mathematical solids, vases, etc., with stand, complete in a substantial box, per set,	25.00

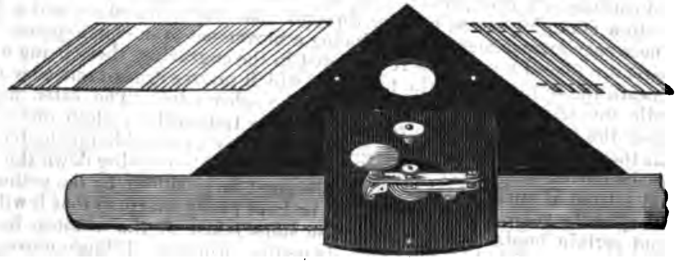
SECTION LINERS.

685½. Harden's Section Liner, as shown in Fig. 1, with adjustable scalo, for parallel lining,	3.75
Harden's Section Liner, as shown in Fig. 2, can be used for shading cylinders or parallel lining,	3.75



Harden's Improved Section Liner, either Nos. 1 or 2, as shown above, each, $3.75

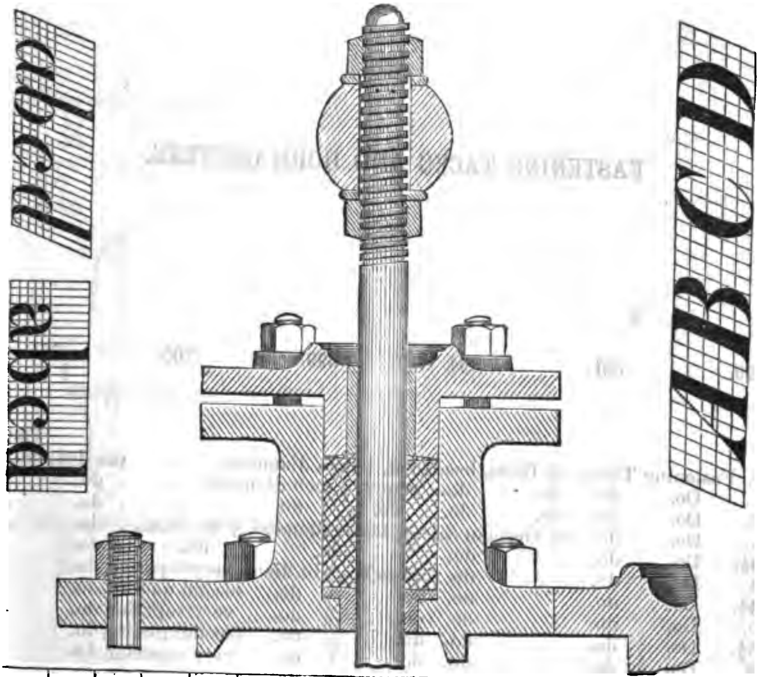
BERGNER'S PATENT SECTION LINER.

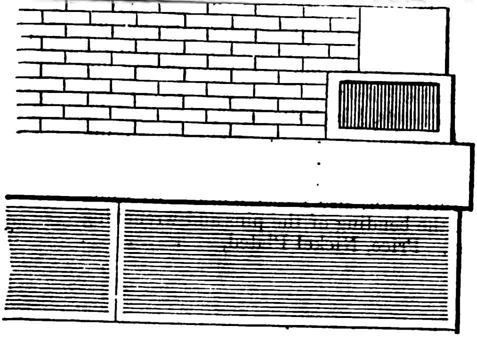


686.

686. Bergner's Patent Section Liner, in morocco case, ... $7.50

SAMPLES OF WORK DONE WITH BERGNER'S PATENT SECTION LINER.





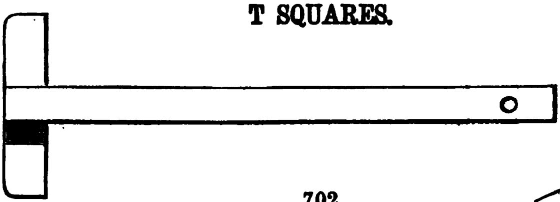
This Instrument is for indicating sections of objects in mechanical and architectural drawings, for drawing screw threads, laying out the spaces for brick work, letterings on drawings, and all cases where narrow spaced parallel lines are needed. With it a person of moderate ability or practice can produce an effect of uniformity and neatness, in sectional drawings, almost, or quite equal to the engine dividing of engravings. The instrument consists of a ruler, covered on the under side with India-rubber cloth, a triangle with a clamping-screw, passing through near one of its edges, and a plate, with the necessary arrangement for producing a movement over equal spaces. The several parts are placed together as represented in the engraving, there being a little spring beneath the front edge of the top plate, which presses against one edge of the ruler, while the triangle is clamped against the other edge. The ruler may be placed upon the paper in any desired position, the India-rubber cloth underneath keeping it there with perfect security, and it thus acts as a guide for the triangle, which can be moved along over equal steps by alternately pressing down the ivory button and letting it spring back. This movement is produced by the action of a little pawl upon the ruler, which is always to be kept pretty sharp, so that it will take a quick and certain hold. The length of the steps taken, or the distance between the lines drawn, is regulated by the screw above the spring, the distance moved over each time being greater as the spring is allowed to have more play. By changing the clamping-screw on the triangle, any edge can be placed against the ruler.

FASTENING TACKS AND HORN CENTRES.

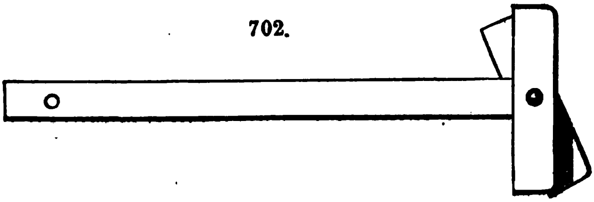
690. 691. 694. 699. 700. 701.

No.			Price.
690.	Fastening Tacks, of Brass, heads flat, ¼ inch diameter, .	per doz.,	$0.20
691.	Do. do. do. do. round, ¼ inch diameter, . .	do.	.25
692.	Do. do. do. do. do. 7/16 do. . .	do.	.35
693.	Do. do. of German Silver, heads rounded, ¼ in. diam., .	do.	.45
693½.	Do. do. do. do. 7/16 do. .	do.	.50
694.	Do. do. do. flat heads, 5/16 in. diam., very superior,	do.	.60
694½.	Do. do. do. do. 5/16 do. second quality,	do.	.30
695.	Do. do. do. do. 7/16 do. very superior,	do.	.65
695½.	Do. do. do. do. 7/16 do. second quality,	do.	.40
696.	Do. do. do. do. ½ do. very superior,	do.	.75
696½.	Do. do. do. do. ½ do. second quality,	do.	.45
697.	Do. do. do. do. 9/16 do. very superior,	do.	.85
697½.	Do. do. do. do. ⅝ do. very superior,	do.	1.00
697½*b*.	Do. do. do. do. ⅝ do. second quality,	do.	.55
697¾.	½ inch diameter, extra long Needle Points, ...	do.	1.00
698.	Fastening Tacks, of Steel, round heads, ¼ inch diameter, . .	do.	.40
699.	Do. do. of Brass, right-angled, ...	do.	.75
700.	Horn Centre, ...	each,	.15
701.	Do. with German Silver Rim, ...	do.	.35
701½.	Thumb Tack Extractor and Impressor, also Paper Knife. By using this handy little instrument the bending of the pins and wrenching off of the heads are avoided. Price, Nickel Plated, . . .		.25

T SQUARES.



702.



703.

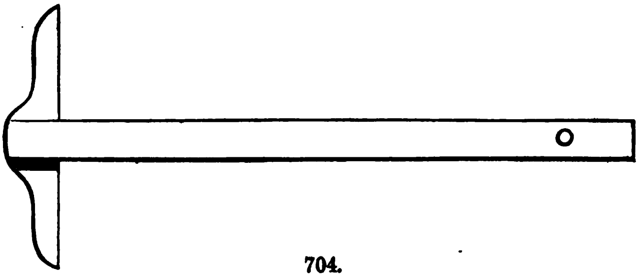
No.

702. Pearwood T Square, fixed head.

15	20	25	30	35	40	45	50	70 inches long.
.30	.45	.45	.50	.65	.85	$1.00	1.25	2.00

703. Pearwood T Square, shifting head.

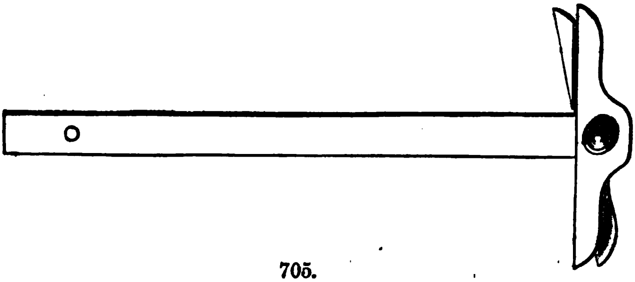
20	25	30	35	40	50	70 inches long.
$1.00	1.00	1.10	1.20	1.50	1.75	2.50



704.

704. Maple Blade, Black Walnut Head, fixed.

20	25	30	35	50	60 inches long.
.65	.75	.85	$1.00	1.25	1.60



705.

705. Maple Blade, Black Walnut Head, shifting.

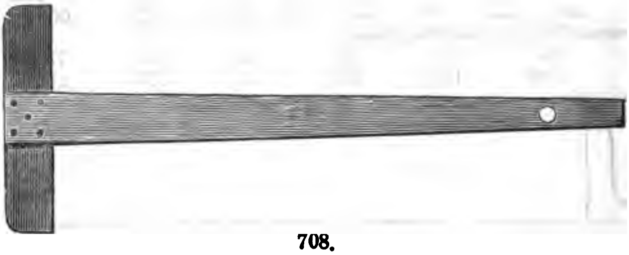
20	25	30	40	55 inches long.
$1.10	1.25	1.40	1.60	2.00

706.

QUEEN'S DOVETAIL SEPARABLE T SQUARE.

The great advantage in above Square is that the head is detachable from the blade, which, without impairing its strength and firmness when fixed, makes it much more convenient for carrying.

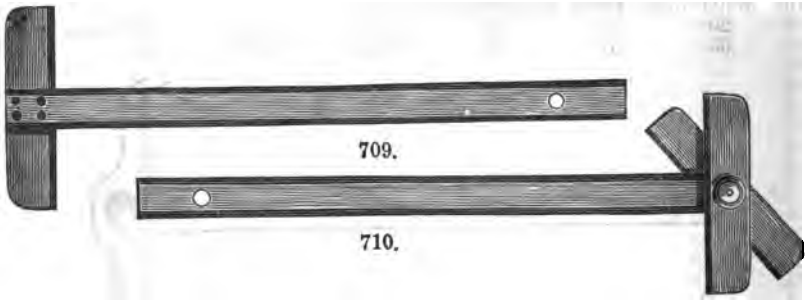
706. Price, 25-inch Blade, 60 cents; 30-inch Blade, 75 cents; 35-inch Blade, 90 cents.



708.

708. Hardwood Blade, tapered, Black Walnut Head.

30	40	50 inches long.
$1.25	1.75	2.00



709.

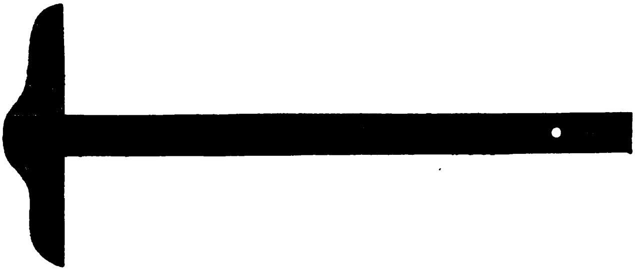
710.

709. Mahogany, Ebony lined, fixed heads.

25	30	35	42	50	60 inches long.
$1.25	1.50	1.75	2.00	2.50	4.00

710. Mahogany, Ebony lined, shifting head.

25	30	35	42	50	60 inches long.
$2.25	2.50	2.75	3.25	3.50	5.00

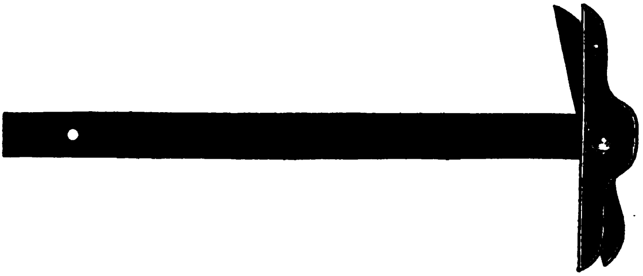


711.

No. **PRICE.**

711. **Rubber Blades, Black Walnut Head, fixed.**

12	**15**	**20**	**25**	**30**	**36 inches long.**
.60	**.65**	**.80**	**$1.00**	**1.25**	**1.75**



712.

712. **Rubber Blades, Black Walnut Head, shifting.**

15	**20**	**25**	**30**	**35 inches long.**
$1.50	**1.75**	**2.00**	**2.50**	**2.75**

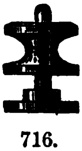
713. **Steel Blades, Nickel Plated, Japanned Iron Heads.**

18	**24**	**30**	**35 inches long.**
$3.25	**4.50**	**5.50**	**6.50**

714. **Steel Blades, Nickel Plated, Japanned Iron Heads, shifting head.**

18	**24**	**30**	**35 inches long.**
$4.75	**6.00**	**7.00**	**8.00**

715. **Bronze Heads, Steel Blade, with Protractor Head, graduated to half degrees, blade 36 inches long,** **$16.00**

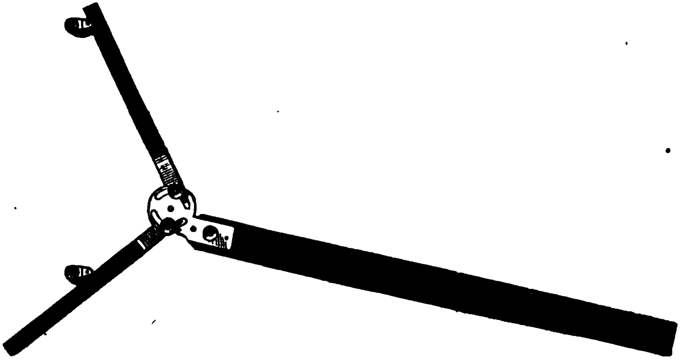


716.

716. **Brass Swivel for T Square, with nut and washer,** . . . . . . **.60**

717. **Same as 716, but of German silver,** . . . . **.85**

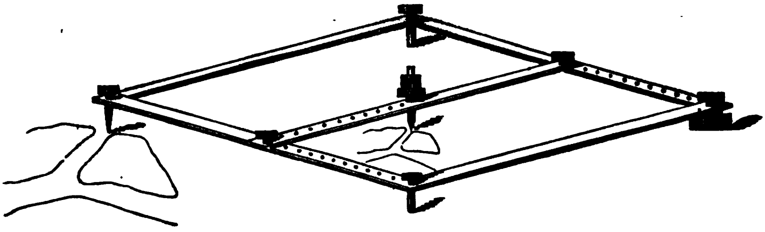
CENTROLINEAD.



733.

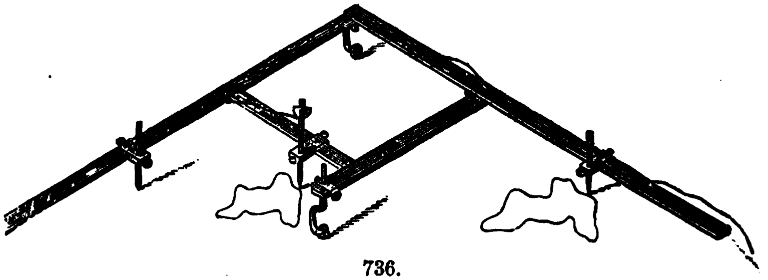
No.		Price.
733.	Centrolinead, of wood, for perspective drawing, arms 24 inches, . .	$5.00
733½.	Do. do. do. do. do. 36 do. . .	6.50

PANTOGRAPHS.



734.

734.	Pantograph of hardwood arms, ...	3.00
735.	Do. pearwood, arms 22 inches long, ...	5.50



736.

736.	Pantograph of black wood, with Brass Joints and Mountings, Iron and Lead Weights and complete Fittings, of good comstruction, for fine work, arms 20 inches long, in case, each, ...	18.0
737.	Pantrograph of ebony, in box, arms 24 inches long, ...	25.0
738.	Do. brass, do. 24 do. . . .	60.0
739.	Do. do. do. 30 do. . . .	70.00

PARALLEL RULERS.

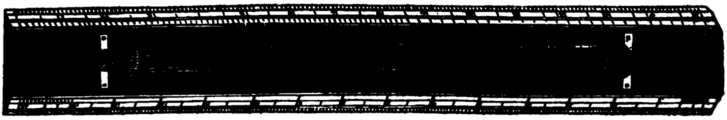
750.

No.		Price.
750.	Parallel Rulers, ebony, brass mounted, 6 inches long, each, . .	$0.25
751.	Do. do. do. 9 do. do. . .	.50
752.	Do. do. do. 12 do. do. . .	.75
753.	Do. do. do. 15 do. do. . .	1.00
754.	Do. do. do. 18 do. do. . .	1.25
755.	Do. do. do. 24 do. do. . .	2.00
756.	Do. German silver mounted, 12 inches long, each, . .	1.25

ROLLING PARALLEL RULERS.

759.

759.	Parallel Ruler, all German silver, on rollers, 12 inches long, . .	10.00
760.	Do. do. do. 15 do. . .	12.00
761.	Do. do. do. 18 do. . .	15.00
762.	Do. all brass, on rollers, 9 inches long, ...	6.50
763.	Do. do. do. 12 do.	8.00
764.	Do. do. do. 15 do.	10.00
764½.	Do. do. do. 18 do.	12.00
765.	Do. ebony, do. 12 do.	3.25
766.	Do. do. do. 15 do.	4.00
767.	Do. do. do. 18 do.	5.00



768.

768.	Parallel Ruler, ebony, ivory graduated edges, on rollers, 12 inches long,	5.00
769.	Do. do. do. do. 15 do.	6.50
770.	Do. do. do. do. 18 do.	7.50

DRAWING PAPERS IN SHEETS.

No. Price.

800. WHATMAN'S HOT AND COLD-PRESSED DRAWING PAPERS, SELECTED.

Whatman's Papers, hot-pressed, have smooth surfaces; cold-pressed have fine grain surfaces. In ordering, customers will please state which surface they desire.

We import and sell only the best quality of Whatman's hand-made papers.

Demy,	20x15	inches,	per quire,	$1.00,	per sheet,	$0.06
Medium,	22x17	do.	do.	1.50,	do.	.08
Royal,	24x19	do.	do.	1.85,	do.	.10
Super-royal,	27x19	do.	do.	2.40,	do.	.12
Imperial,	30x21	do.	do.	3.50,	do.	.20
Atlas,	33x26	do.	do.	4.50,	do.	.25
Double Elephant,	40x26	do.	do.	5.50,	do.	.30
Antiquarian,	52x31	do.	do.	30.00,	do.	1.50

800 B. WHATMAN'S DRAWING PAPER. EXTRA WEIGHT.

Imperial,	per quire,	$9.00,	per sheet,	.45
Double Elephant,	do.	14.00,	do.	.75

801. MACHINE PAPERS. SUITABLE FOR PENCIL DRAWINGS.

Demy, 20x15 inches,	per quire,	$0.60,	per sheet,	.04
Medium,	do.	.75,	do.	.05
Royal,	do.	1.00,	do.	.06
Super-royal,	do.	1.25,	do.	.08
Imperial,	do.	1.50,	do.	.10
Double Elephant,	do.	2.50,	do.	.20

DRAWING PAPERS IN CONTINUOUS ROLLS.

Our line of white roll Drawing Papers has been carefully selected and manufactured. Being made from linen stock, the quality is unsurpassed, and we believe that it will fully meet the wants of all engineering or architectural draughtsmen. Samples of any of the papers will be sent on application. The following brief description may aid our customers in selecting a paper suited to their wants:

The Constantia Paper is of good quality, medium in weight, with a slight grain and tint.

The I X L brand has a smooth surface on one side. The reverse is slightly roughened. The smooth side is especially suitable for drawings intended to be photographed. The rough for fine office drawings.

The Acme, for general drafting, is unsurpassed. The color is white. The grain similar to the well-known Egg Shell, but much more regular and uniform. It is extremely strong, and stands handling and erasing perfectly.

The Egg Shell Paper, having a rough, grainy surface, works up nicely in water colors.

The Leonine is an extra stout, tinted paper, suitable for shop drawings requiring rough handling.

No. PRICE.

802.

CONTINUOUS DRAWING PAPERS—WHITE.

IN ROLLS OF 30 TO 40 POUNDS.

				Per lb.	Per roll of 10 yards.	Per yd.
Constantia,	36	in wide,	thin,	$0.45	$2.25	$0.25
I X L,	42	do.	medium,	.45	3.00	.35
Do.	58	do.	thick,	.45	5.00	.60
Acme,	42	do.	medium,	.45	3.00	.35
Do.	58	do.	do.	.45	4.00	.45
Do.	58	do.	thick,	.45	5.00	.60
Egg Shell,	42	do.	medium weight and surface,	.45	3.00	.35
Do.	42	do.	medium weight, rough surface,	.45	3.00	.35
Do.	58	do.	thin,	.45	3.75	.40
Do.	58	do.	medium weight, medium surface,	.45	4.00	.45
Do.	58	do.	medium weight, smooth surface,	.45	4.00	.45
Do.	58	do.	heavy weight, rough surface,	.45	4.50	.50
Leonine,	62	do.		.45	4.50	.50

The pound price applies only to full, unbroken rolls.

803.

MUSLIN BACKED CONTINUOUS ROLL DRAWING PAPER.

IN ROLLS OF 10 YARDS.

				Per roll.	Per yd.
Constantia,	36	in. wide,	medium weight,	$8 50	$0.90
Acme,	36	do.	medium,	8.50	.90
I X L,	42	do.	rough or smooth surface,	9.00	1.10
Acme,	42	do.	medium,	9.00	1.10
Egg Shell,	42	do.	do.	9.00	1.10
I X L,	54	do.	rough or smooth surface, thick,	12.50	1.35
Acme,	54	do.	medium weight,	12.00	1.35
Do.	54	do.	heavy,	12.50	1.40
Egg Shell,	54	do.	thin or medium weight,	12.00	1.25
I X L,	58	do.	thick, rough, or smooth surface,	13.50	1.60
Acme,	58	do.	medium,	12.50	1.40
Do.	58	do.	heavy,	13.50	1.60
Egg Shell,	58	do.	thin or medium,	12.50	1.40
Do.	58	do.	thick,	13.50	1.60
Leonine,	62	do.		13.50	1.60
English Manilla Paper, 54 inches,				12.00	1.35

803½.

WHATMAN'S DRAWING PAPER, MOUNTED.

Whatman's Double Elephant, per sheet,	.75
Do. Antiquarian, do.	1.75

Mounting large sheets for maps a specialty.

804.

CONTINUOUS DRAWING PAPER, BUFF TINT, FOR WORKING DRAWINGS.

BEST ENGLISH MAKE, IN ROLLS OF 50 TO 80 POUNDS.

40 inches wide, medium thickness, per pound,	$0.50,	per yard,	.25
54 do. do. do.	.50,	do.	.35

BEST AMERICAN MAKE, IN ROLLS OF 70 TO 100 POUNDS.

36 inches wide, thick, per pound,	$0.15,	per yard,	.10
42 do. do. do.	.15,	do.	.12
48 do. do. do.	.15,	do.	.15
54 do. do. do.	.15,	do.	.18

Full rolls only of continuous paper sold by the pound at above rates.

804 A.

GREY DRAWING PAPER FOR DETAILS, VERY SUPERIOR.

57 inches wide, per pound,	$0.45	per yard,	.35

No.		Price.
804½.	Architects' Manilla Sketching Paper, 31x50, per quire, $7.50; per sheet, This paper is an entirely new article, needs no stretching, will not buckle, and is especially recommended.	$0.40

ROLL DRAWING PAPERS FOR SENSITIZING.

42 inches wide, per roll of 55 yards,	8.50
60 do. do. do.	12.00
Steinbach's, 53 inches wide, very superior, light, per yard,	.35
Do. do. do. heavy, do.	.50

805. TRACING OR VELLUM CLOTH.

In Rolls of 24 yards, both sides glazed, or face glazed and back dull, suitable for pencil marks.

Imperial,	18	inches wide,	per roll,	$5.00;	per yard,	.25
Do.	30	do.	do.	6.90;	do.	.40
Do.	36	do.	do.	7.50;	do.	.45
Do.	42	do.	do.	10.50;	do.	.60
Sagar's Patent,	18	do.	do.	4.10;	do.	.25
Do.	30	do.	do.	7.40;	do.	.40
Do.	36	do.	do.	8.00;	do.	.45
Do.	42	do.	do.	11.00;	do.	.60

TRACING PAPERS IN SHEETS.

806.	French, in Sheets. Royal, 19x25 inches,	per quire,	1.00
807.	Do. do. Super-royal, 21x26 inches,	do.	1.50
808.	Do. do. Double Elephant, 28x40 inches,	do.	2.50
811.	Do. Vegetable Royal, 19x25 inches, per quire, $2.20;	per sheet,	.12
812.	Do. do. Super-royal, 21x26 inches, do. 3.50;	do.	.40
813.	Do. do. Double Elephant, 28x40 do. do. 10.00;	do.	.50
815.	English, in Sheets, 20x30 inches, do. 1.50;	do.	.10
815½.	Do. do. 40x30 do. do. 3.00;	do.	.15
816.	Do. finest quality, in sheets, 20x30 in., do. 2.50;	do.	.15
816½.	Do. do. do. 40x30 do. do. 5.00;	do.	.25

TRACING PAPERS IN ROLLS.

816¾A.	English, in rolls of 20 yards, 40 inches wide, per roll,	4.00
B.	French, common, in rolls of 11 yards, 43 inches wide, per roll,	1.50
C.	Do. do. do. 22 do. 43 do. do.	2.50
D.	Do. vegetable, do. 22 do. 54 do. do.	5.00
E.	Parchment, very tough and transparent, and does not discolor from age, in rolls of 33 yards, 38 inches wide, per roll,	8.00
F.	German, not prepared, in rolls of 33 yards, 54 inches wide, per roll,	5.00
G.	German, thin, tough, and transparent, in rolls, 43 do. 22 yards long, per roll,	4.50
H.	Same as G, but extra stout and heavy,	5.00

REYNOLD'S BRISTOL BOARD.

			2 Sheets.	3 Sheets.	4 Sheets.
12¾x16¼	inches Cap,	per dozen,	$0.70	$1.10	$1.40
14¼x18½	do. Demy,	do.	1.10	1.50	1.80
16½x20¾	do. Medium,	do.	1.40	1.80	2.50
18 x22½	do. Royal,	do.	2.00	2.75	3.50

Bond-paper, for tracings, very tough.

	16x21	16x24	19x24	19x30 inches.
per 100 sheets,	$3.25	3.75	4.00	5.00

English Parchment.

	16x20	18x20	18x22	18x24	20x24 inches.
per dozen,	$5.25	6.00	7.00	7.25	7.50

Gelatine or Glass-paper,	13x19	17x21 inches.
per dozen,	$3.50	4.00

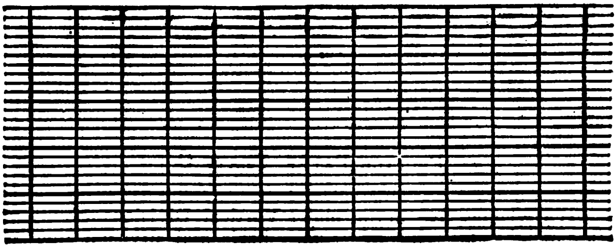
Transfer Paper, blue, red, and black, 18½x23 inches, Royal, per dozen,	$2.50
White Mounting Board, 22x28 inches, according to thickness, per sheet,	.15 to .25

PROFILE PAPERS.

Printed in red or green.

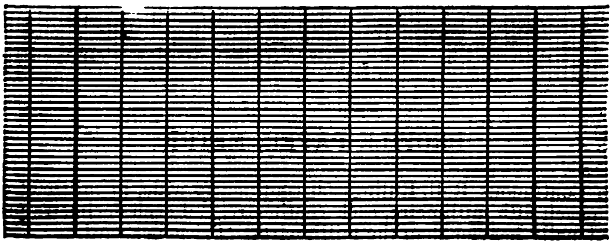
After a long series of experiments, we are now prepared to furnish in sheets, and in continuous rolls, a perfect article of Profile Paper. Our plates, A and B, are so well known amongst engineers, and have met with such universal approval, that a detailed description of the rulings seems unnecessary.

We have recently added another plate with metric divisions, which, we trust, will meet the wants of the engineering profession desiring to use this scale.



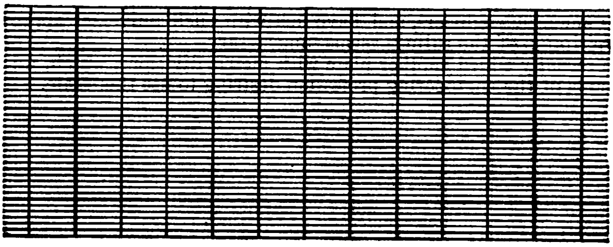
PROFILE PAPER, PLATE A.

No.		PRICE.
820.	In Sheets, Rulings 42 inches long by 15 inches wide; Horizontal Divisions, four to the inch; Vertical Divisions, twenty to the inch, and having every tenth horizontal division line and every fiftieth vertical division line heavier than the others. Price, per quire, $8.50; per sheet, ...	$0.40
1.	In Sheets, 42x6½ inches, per quire, $6.50; per sheet, ...	.30
2.	In Continuous Rolls, Rulings 20 inches wide, per yard, ...	.30
3.	Muslin Backed, Rulings 20 inches wide, in rolls of 20 yards, per yard,	.75
4.	Printed on Tracing Cloth, Rulings 42x15 inches, per sheet, .	1.00



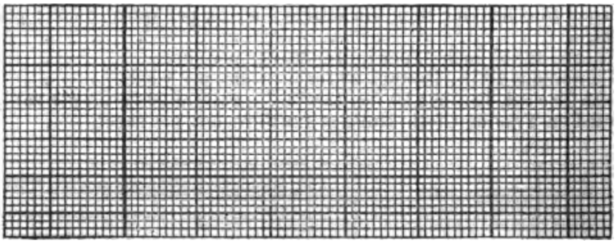
PROFILE PAPER, PLATE B.

No.		Price.
822.	Horizontal Divisions, four to the inch; Vertical Divisions, thirty to the inch, and having every fourth horizontal division line and every twenty-fifth vertical division line heavier than the others.	
	1. Plate B.—In Sheets, Rulings 14 inches long by 13 inches wide, per quire, $8.50; . . . . per sheet,	.40
	2. Plate B.—In Sheets, Rulings 42x6½ inches, per quire, $6.50; per sheet,	.30
	3. Plate B.—In Continuous Roll, Rulings 20 inches wide, per yard, .	.30
	4. Plate B.—In Continuous Roll, Rulings 9 inches wide, per yard, .	.20
	5. Plate B.—Muslin Backed, Rulings 20 inches wide, in rolls of 20 yards, per yard, ...	.75
	6. Plate B.—Muslin Backed, Rulings 9 inches wide, in rolls of 20 yards, per yard, ...	.50
	7. Plate B.—Printed on Tracing Cloth, Rulings 42x15 inches, per sheet,	1.00



PROFILE PAPER, PLATE C.

No.		Price.
824.	Horizontal Divisions, five to the inch; Vertical Divisions, twenty-five to the inch, and having every fifth horizontal division line and every twenty-fifth vertical division line heavier than the others; in Sheets, Rulings 42 inches long by 15 inches wide, per quire, $8.50; per sheet, ...	.40



PROFILE PAPER, METRIC.

Metric.	—In Continuous Roll, Rulings 50 centimetres wide, in millimetres, with each fifth millimetre, each centimetre, and each decimetre proportionally heavier than the millimetres. Price, per yard, . .	.30
Metric.	—Muslin Backed, Rulings 20 inches wide, in rolls of 20 yards, per yard, ...	.75

CROSS SECTION PAPERS.

Printed in red or green.

No.		PRICE.
830.	Topographical Paper, 14x17 inches, ruled 400 feet to the inch, per quire, $1.75; per sheet, ...	$0.10
831.	Trautwine's Cross Section and Diagram, 10 feet to inch, for embankments of 14 and 24 feet, roadway, and for excavations of 18 and 28 feet, rulings 19¾x12 inches, per quire, $5.00; per sheet, . . .	.25

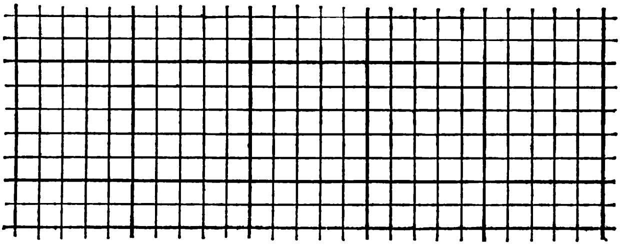


PLATE C.

832.	Cross Section Paper, Plate C, rulings 20x16 inches, 8 feet to inch, per quire, $5.00; per sheet, ...	.25

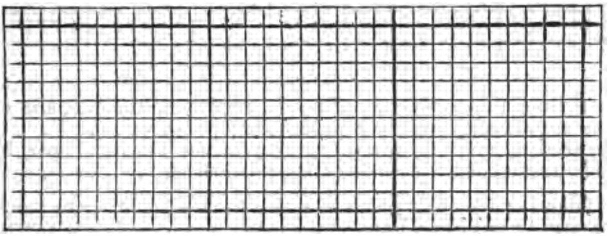


PLATE F.

833.	Cross Section Paper, Plate F, rulings 20x16 inches, 10 feet to inch, per quire, $5.00; per sheet, ...	.25

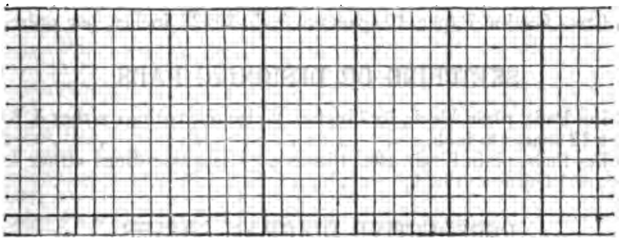


PLATE G.

834.	Cross Section Paper, Plate G, rulings 22x16 inches, 10 feet to inch, every fifth line heavy, per quire, $5.00; per sheet, ...	.25

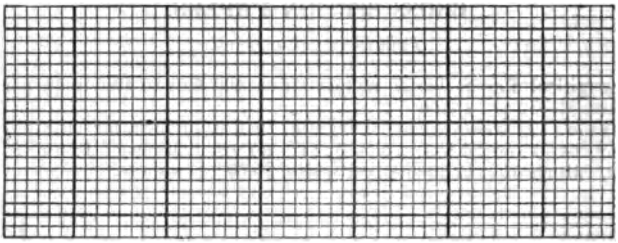
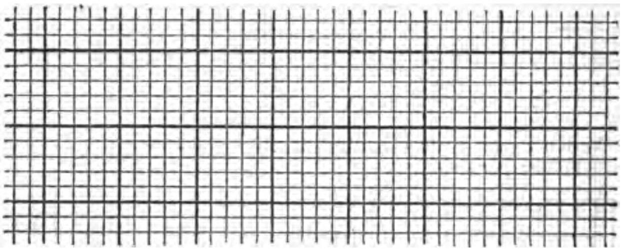


PLATE H.

No		PRICE.
835.	Cross Section Paper, Plate H, rulings 21x16 inches, 16 feet to inch, per quire, $5.00; per sheet,	$0.25



No		PRICE.
835½.	Cross Section Paper, Metric, rulings every two millimetres, size of sheet, 40x50 centimetres, per quire, $5.00; per sheet,	.25
835¾.	Cross Section, Plate G, printed on Parchment Tracing Paper, in sheets, 18x20 inches, per quire, $5.00; per sheet,	.25

The following list of Cross Section Papers, being ruled, are much cheaper than those printed from copper plates, and are sufficiently accurate for sketching or designing purposes.

Ruled Cross Section Paper, 4 spaces to inch, 20x28 inches, per quire,	2.50
Do. do. do. 8 do. 20x28 do. do.	2 50
Do. do. do. 10 do. 20x28 do. do.	2.50
Do. do. do. 10 do. 20x28 do. 5 to block, per quire,	2.50
Ruled Cross Section Paper, 12 spaces to inch, 20x28 inches, per quire,	2.50

SKETCHING OR DESIGNING PADS.

Sketching Pads, plain block, 5x7 inches, 25 leaves, rulings either 4, 8, 10, or 12 spaces to inch,	1.25
Sketching Pads, plain block, 10x14 inches, 25 leaves, rulings either 4, 8, 10, or 12 spaces to inch,	2.50

PERSPECTIVE DIAGRAM SHEETS.

These Diagram Sheets have printed upon them faintly tinted guide lines for the use of draughtsmen in making drawings. The Rulings being in vertical, horizontal, and perspective lines, it enables a draughtsman to sketch any object in its correct position, proportion, and in true perspective.

PLATE No. 1.

Showing in parallel perspective the interior of a 12-inch square, 12 feet deep, the sides of the square divided into sixteenths of inches.

PLATE No. 2.

Showing in oblique perspective (45°) from a point of sight three feet distant, a 12-inch cube divided into eighths.

PLATE No. 3.

Showing in oblique perspective (30° 60°) from a point of sight three feet distant, a 12-inch cube divided into eighths of inches, except the perpendicular lines on narrow face, which are divided into quarters of inches.

Nos. 1, 2, and 3.

No.		Price.
	The Plates, as described above, are printed on sheets 14x17 inches, on paper, for pencil or ink, per dozen, $3.00; per copy,	$0.50
	On Whatman's paper, for water colors, per dozen, $4.50; per copy,	.75

Reduced Copy of Plate No. 2.

No.		Price.
	Reduced to one-third each way, 4, each,	.15

HOWSON'S ISOMETRICAL SKETCHING CHARTS.

These Ruled Charts will be found to be very convenient in teaching Isometrical perspective, as well as an aid in free-hand sketching, or drawing elevations or plans of machinery.

No.		Price.
	Rulings 5x9½ inches, per tablet of 50 leaves,	1.00

WEAVERS' DESIGN PAPERS.

No.		Price.
836.	1. Design Paper, Rulings 4x4 to block, block 1 inch square, per quire, $3.00; per sheet,	.15
	2. Design Paper, Rulings 5x5 to block, block ½ inch square, per quire, $3.00; per sheet,	.15
	3. Design Paper, Rulings 5x5 to block, block ⅝ of an inch square, per quire, $3.00; per sheet,	.15
	4. Design Paper, Rulings 5x5 to block, block ⅞ of an inch square, per quire, $3.00; per sheet,	.15
	5. Design Paper, Rulings 6x8 to block, per quire, $3.00; per sheet,	.15
	6. Design Paper, Rulings 8x8 to block, block $\frac{7}{16}$ of an inch square, per quire, $3 00; per sheet,	.15
	7. Design Paper, Rulings 8x8 to block, block $\frac{1}{8}$ of an inch square, per quire, $3.00; per sheet,	.15
	8. Design Paper, Rulings 8x8 to block, block 1 inch square, per quire, $3.00; per sheet,	.15
	9. Design Paper, Rulings 8x16 to block, block ⅝ of an inch square, per quire, $3.00; per sheet,	.15
	10. Design Paper, Rulings 10x10 to block, block 1 inch square, per quire, $3.00; per sheet,	.15
	11. Design Paper, Rulings 12x12 to block, block $\frac{9}{16}$ of an inch square, per quire, $5.00; per sheet,	.25
	12. Design Paper, Rulings 12x12 to block, block 1 inch square, per quire, $5.00; per sheet,	.25
	13. Design Paper, Rulings 8x10 to block, per quire, $5.00; per sheet,	.25
	14. Design Paper, Rulings 8x12 to block, per quire, $5.00; per sheet.	.25
	15. Design Paper, Rulings 15x15 to block, block 1 inch square, per quire, $3.00; per sheet,	.25
	16. Design Paper, Rulings 8x9 to block, block $\frac{7}{16}$ of an inch square, per quire, $3.00; per sheet,	.15
839.	Patent Office Blanks, per dozen, $1.00; per sheet,	.10

TOWNSHIP PLOTTING PAPER.

No.		Price
839½.	Township Plotting Paper, Rulings 6x6 blocks, blocks 1 inch square, per 100 sheets, ...	$2.00
	Township Plotting Paper, Rulings 12x12 blocks, blocks 2 inches square, per 100 sheets, ...	2.50

LYONS' TABLES.

840. Lyons' Tables. A set of Tables for finding at a glance the true cubical contents of Excavation and Embankments for all Bases, and for every variety of Ground and Side Slopes. By M. E. Lyons, C. E.

Sheet No.	1.	General Table for all Bases and all Slopes.			
Do.	2.	For Side Hill Cuts and Fills.			
Do.	3.	Base	12	feet Slopes, ...	1½ to 1
Do.	4.	do.	14	do.	1½ to 1
Do.	5.	do.	15	do.	¼ to 1
Do.	6.	do.	15	do.	1 to 1
Do.	7.	do.	15	do.	1½ to 1
Do.	8.	do.	16	do.	¼ to 1
Do.	9.	do.	16	do.	1 to 1
Do.	10.	do.	18	do.	¼ to 1
Do.	11.	do.	18	do.	¾ to 1
Do.	12.	do.	18	do.	1 to 1
Do.	13.	do.	18	do.	1½ to 1
Do.	14.	do.	20	do.	1½ to 1
Do.	15.	do.	24	do.	¼ to 1
Do.	16.	do.	24	do.	1½ to 1
Do.	17.	do.	25	do.	1½ to 1
Do.	18.	do.	26	do.	1½ to 1
Do.	19.	do.	28	do.	¼ to 1
Do.	20.	do.	30	do.	1 to 1
Do.	21.	do.	30	do.	1¼ to 1
Do.	22.	do.	30	do.	1½ to 1
Do.	23.	do.	32	do.	1 to 1
Do.	24.	do.	32	do.	1½ to 1

The Tables are printed in clear, bold type, on tinted paper, sheets 25x16 inches. They may be used by candle-light without injuring the eyesight. Each sheet is complete in itself, and embraces all that is wanted in connection with the Base or Slope designated, whether on level or side-hill cross section.

Per sheet, 25 cents; bound in one volume, ...	8.50

☞ A sample book of all our papers, from 800 to 835, sent on receipt of 10 cents.

840½.	Table for reducing perches to feet, also decimal parts of a foot for each inch and sixteenth of an inch, per sheet, ...	.25

THE BLUE PROCESS OF COPYING TRACINGS.

Special attention has recently been directed to this easy process of copying tracings, and its great value to all Engineers, Architects, and Mechanical Draughtsmen fully recognized.

The instructions in using are—

1. Provide a flat board as large as the tracing which is to be copied.
2. Lay on this board two or three thicknesses of common blanket or its equivalent, to give a slightly yielding backing for the paper.
3. Lay on the blanket the prepared paper with the sensitive side uppermost.
4. Lay on this paper the tracing, smoothing it out as perfectly as possible, so as to insure a perfect contact with the paper.
5. Lay on the tracing a plate of clear glass, which should be heavy enough to press the tracing close down upon the paper. Ordinary plate glass of three-eighths thickness is quite sufficient.
6. Expose the whole to a clear sunlight by pushing it out on a shelf from a window, or in any other convenient way, from four to six minutes [in winter, six to ten minutes]. If a clear sky only can be had, the exposure must be continued from twenty to thirty minutes, and under a cloudy sky from sixty to ninety minutes may be needed, the shade depending on the time.
7. Remove the prepared paper and wash it freely for one or two minutes in clear water, and hang it by one corner to dry.

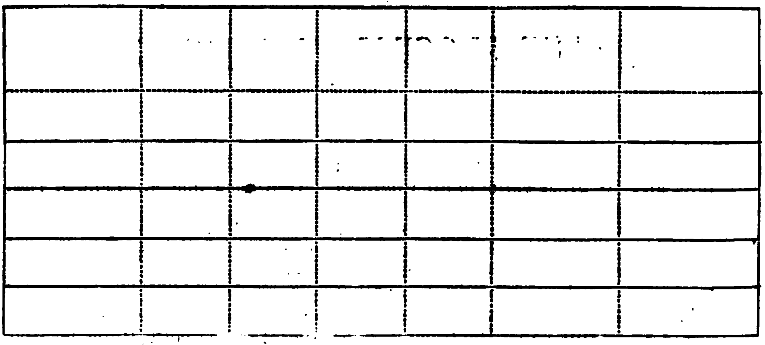
QUEEN & CO.'S PREPARED SENSITIVE PAPERS

Are packed to keep from light, one dozen sheets in each package, and are always ready for immediate use.

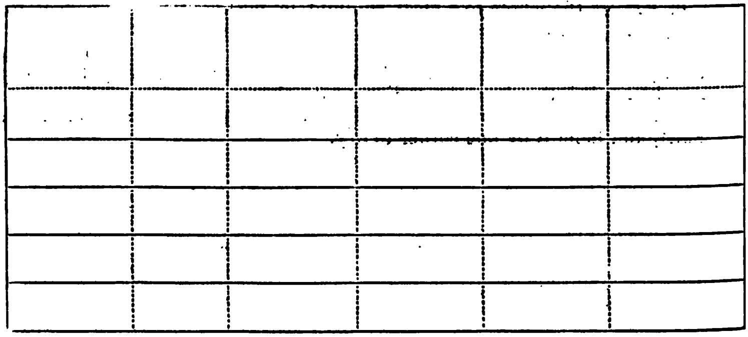
		Price.
Demy, 16x21,	per dozen,	$0.85
Medium, 18x23,	do.	1.25
Royal, 19x24,	do.	1.50
Superroyal, 20x28,	do.	1.65
Double Medium, 23x36,	do.	2.25
Imperial, 23x31,	do.	2.00
Double Elephant, 27x40,	do.	3.50
Antiquarian, 31x53,	do.	6.50
Sensitized Solar Printing Paper, 42 inches wide, in continuous rolls of 10, 20, or 50 yards, per yard,		.40
Photo-solution, per bottle,		4.40

ENGINEERS'

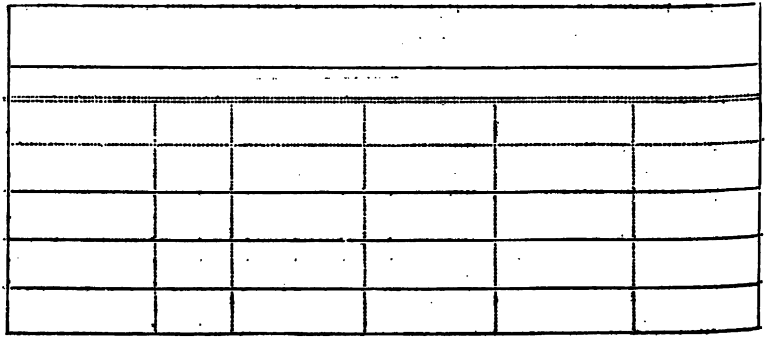
The Solid Lines are Ruled in Black,



841. Level Book, 7 x4 inches, made of superior drawing paper, per dozen, . .
841½. Do. do. 7 x4 do. same as 841, but interleaved with blotting paper, per
842. Do. do. 6¾x4 do. extra smooth paper, per dozen, ...
842½. Profile Level Books, 7x4 inches, Level Ruling on one page, Profile Ruling on



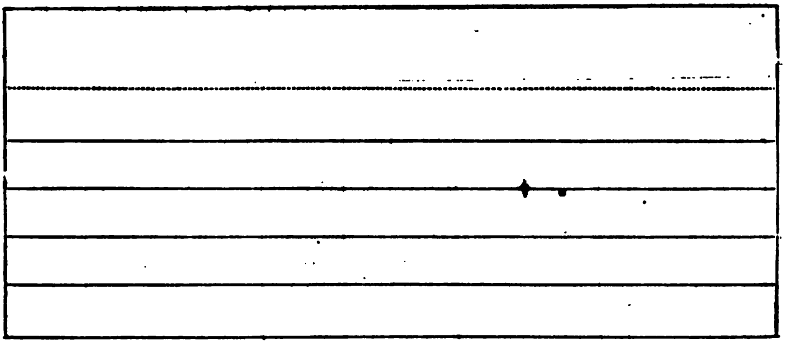
843. Transit Books, 7x4 inches, made of superior drawing paper, per dozen, . .
843½. Do. do. same as 843, but interleaved with blotting paper, per dozen, .
844. Do. do. 6¾x4 inches, extra smooth paper, per dozen, ...



845. Record Books, 7½x5 inches, made of superior paper, per dozen, . . .

FIELD BOOKS.

the Broken Lines in Red.

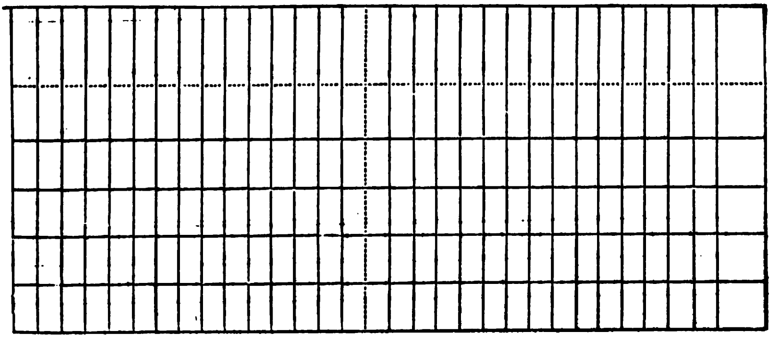


. . . . $6.00

dozen, ... 6.50

. . . . 4.50

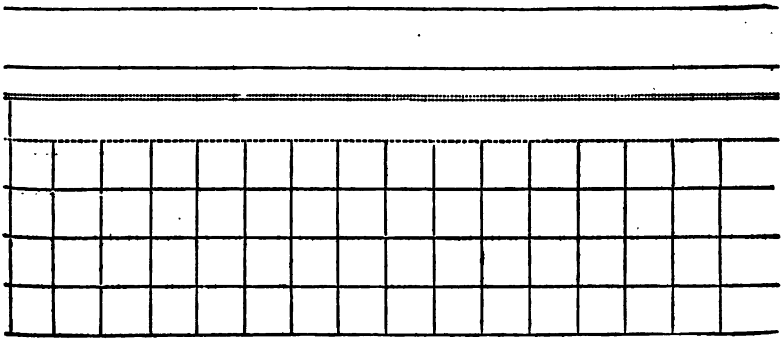
the other, made of superior drawing paper, per dozen, ... 7.50



. . . . 6.00

. . . . 6.50

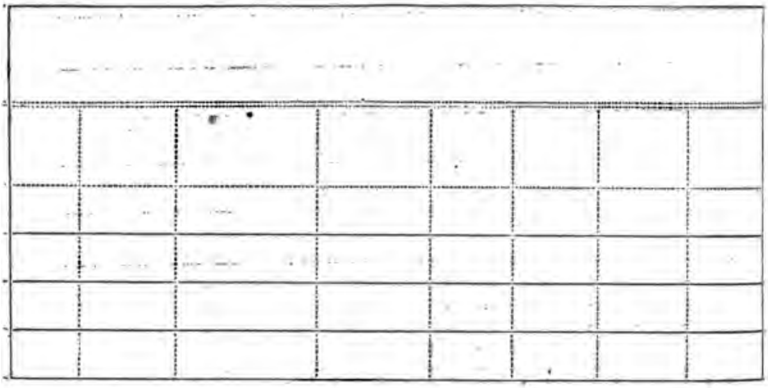
. . . . 4.50



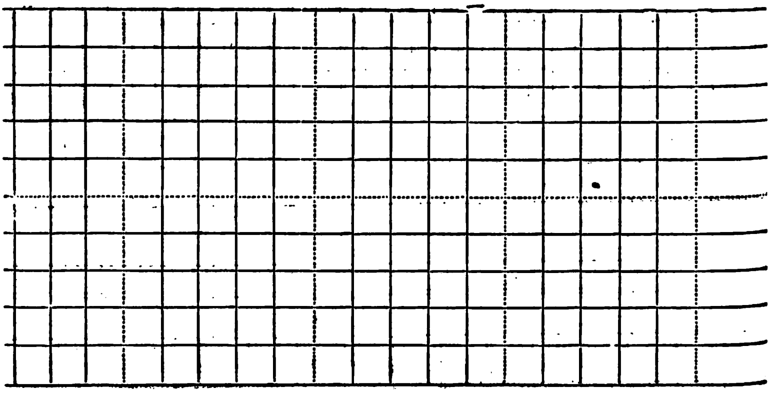
. . . . 9.00

ENGINEERS'

The Solid Lines are Ruled in Black,



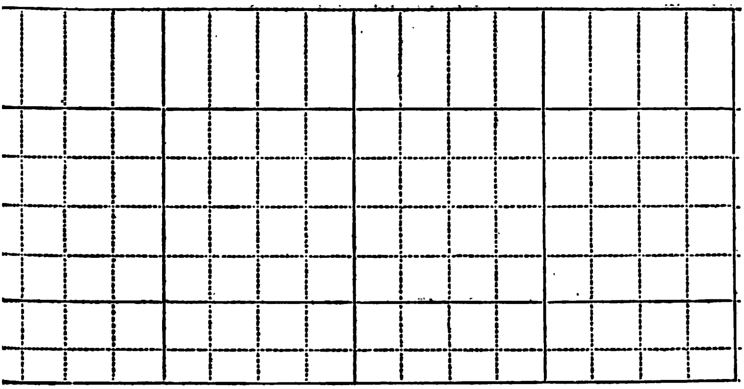
845½. Topographical Books, 8x5½ inches, made of superior paper, per dozen, .



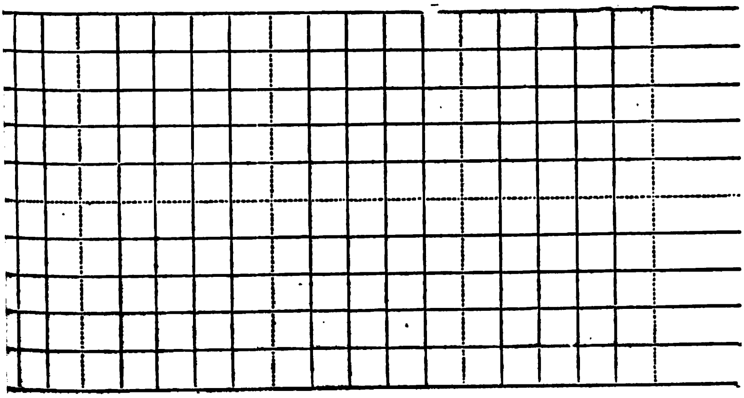
846. Cross-section Book, 8x7 inches, both pages ruled alike, in five divisions to inch
846 A. Do. do. 8x7 do. do. do. in four do. do.
846 B. Do. do. 8x7 do. do. do. in ten do. do.
846 C. Do. do. same ruling as B, but 7x4 inches, per dozen, . . .
846 D. Do. do. 8x7 inches, metric, both pages ruled alike, in squares of five
846 D. Memorandum Books, 4x5½ inches, with faint lines only, per dozen, . .
846 E. Time Books, Weekly or Monthly Notes, 4x6½ inches, per dozen, . . .

IELD BOOKS.

roken Lines in Red.



. . . . $12.00



. . . .	12.00
. . . .	12.00
. . . .	12.00
. . . .	7.50
limeters, per dozen, ...	12.00
. . . .	6.00
. . . .	4.50

BOUND PROFILE BOOKS.

These books are for field or office purposes, being printed on both sides, of a tough, thick paper, and bound in flexible covers convenient for the pocket. Each page will contain a profile of three thousand feet in length, so that each folio will contain an average section of a road as usually laid out for construction. Railroad and other engineers will find them very useful. Size of book, 9½ by 5¾ inches. The rulings correspond to our large profile plates A and B.

No.		Price.
847.	Plate A, 25 leaves, imitation Turkey morocco, with elastic band, . .	$3.50
	Do. 50 do. do. do. do. . .	5.00
	Do. 100 do. do. do. do. . .	8.00
	Do. 50 do. Turkey morocco, turned edges, with elastic band, .	6.00
	Do. 100 do. do. do. do .	9.00
848.	Plate B, 25 do. imitation Turkey morocco, with elastic band, . .	3.50
	Do. 50 do. do. do. do. . .	5.00
	Do. 100 do. do. do. do. . .	8.00
	Do. 50 do. Turkey morocco, turned edges, with elastic band, .	6.00
	Do. 100 do. do. do. do. .	9.00

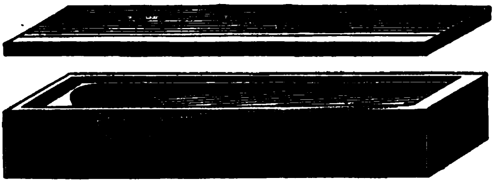
CONTINUOUS PROFILE BOOKS.

These are an improvement over No. 848, as described above, as they admit of the use of a continuous sheet for profile use. They are printed upon fine sheets of paper, and mounted upon a continuous piece of muslin and bound in book form.

848½.	Plate A, 8x5½ inches, profile 12 miles, bound in morocco, with band, .	$3.00
	Do. do. do. 25 do. do. do. do. .	5.00
	Do. do. do. 50 do. do. do. do. .	8.50
	Do. do. do. 100 do. do. do. do. .	14.00
848¾.	Do. B, 8x4¾ inches, do. 12 do. do. do. do. ,	3.00
	Do. do. do. 25 do. do. do. do. .	5.00
	Do. do. do. 50 do. do. do. do. .	8.50
	Do. do. do. 100 do. do. do. do. .	14.00

Profile Books, either plate, bound in seal skin, with turned edges, $1.50 additional to the above prices. Special lengths made to order and bound as may be desired.

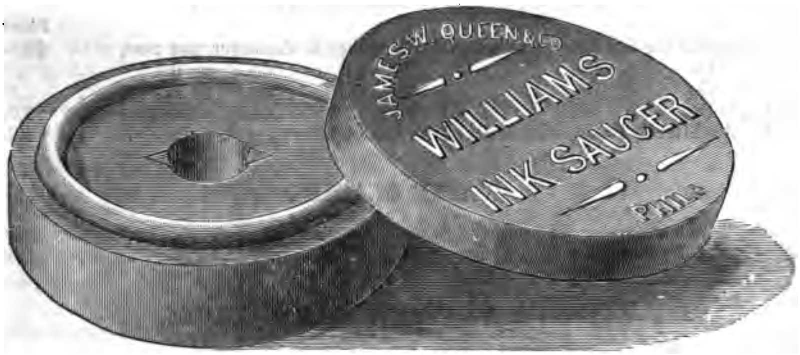
INK SLABS AND SAUCERS.



849.

849.	Patent Ink Slab, with cover, 1¾x4½ inches, each, ...	.50
850.	Do. do. do. 2⅛x5¾ do.	.60

WILLIAMS' INK SAUCER.



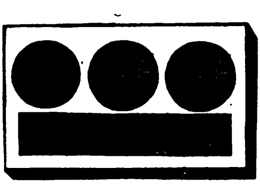
Various forms and sizes of China Nests and Slabs have long been in use for grinding or mixing India Ink and Water Colors, but none now in the market combine so many desirable qualities as the Cup shown in above cut. It consists of a saucer 3¼ inches in diameter, made of specially prepared milk-white glass, with cover; both are made with great care to prevent chipping or breakage, which avoids the objection to those having covers now in use. All edges of the cover and saucer which touch are ground, thus making it air-tight, and by preventing evaporation, preserves the ink as long as may be desired. The grinding surface is made either smooth or roughened, and is sunk sufficiently far below the lip as to prevent the annoyance of the ink splashing on the outside whilst being mixed. In the centre is a deep well, adapted to receive and contain the ground ink.

In short, we feel confident that when once introduced amongst draughtsmen it will meet with the large sale that its cheapness and excellence deserves.

Price, either with smooth or roughened grinding surface, only 50 cents.

PORCELAIN SLABS.

For India Ink and Colors. Containing 3 holes or cups and 1 slanting division.



855.

859.

No.		Price.
855.	Measuring 2¾ by 1½ inches, each, ...	$0.15
856.	Do. 3¾ by 2⅜ do. do.	.25
857.	Do. 4⅜ by 2¾ do. do.	.35
858.	Do. 4¾ by 3 do. do.	.40

CABINET NESTS.

Porcelain Saucers in nests, fitted on each other.

No.		Price.
859.	Containing 5 Saucers and a Cover, 2¼ inches in diameter, per nest,	$0.60
860.	Do. 5 do. do. 2¾ do. do. do.	.70
861.	Do. 5 do. do. 3¼ do. do. do.	.80
861½.	Do. 5 do. do. 3¾ do. do. do.	1.00
861¾.	Architect's Basin, with 8 divisions and cup,	1.35

WATER GLASSES.

Plain, 2-inch diameter, 1¾ inches high, each,	.10
Finely cut, 2¼-inch diameter, 1¼ inches high, each,	.30

WINSOR & NEWTON'S WATER COLORS.

HARD COLORS IN CAKES OR MOIST IN CHINA PANS.

Whole Cake.

Half Cake.

Whole Pan.

862.

Half Pan.

862. Whole cakes or pan, 25 cents each; half cakes or pan, 15 cents each.

Antwerp Blue,
Bistre,
Blue Black,
*British Ink,
Brown Ochre,
Brown Pink,
*Bronze,
Burnt Sienna,
Burnt Umber,
Chinese White,
Chrome Yellow,
Cologne Earth,
Deep Chrome,
*Dragon's Blood,
Emerald Green,
*Flake White,
Gamboge,
Hooker's Green, No. 1,
Hooker's Green, No. 2,
Indigo,
Indian Red,
Italian Pink,
Ivory Black,
*King's Yellow,
Lamp Black,
Light Red,
Naples Yellow,
Neutral Tint,
New Blue,
Olive Green,
Orange Chrome,
Payne's Gray,
Prussian Blue,
Prussian Green,
Raw Sienna,
Raw Umber,
Red Chalk,
*Red Lead,
*Red Ochre,
Roman Ochre,
Sap Green,
Terre Verte,
Vandyke Brown,
Venetian Red,
Vermilion,
Yellow Lake,
Yellow Ochre.

863. Whole cakes or pan, 45 cents each; half cakes or pan, 25 cents each.

*Black Lead,
Brown Madder,
*Chalon's Brown,
*Constant White,
Crimson Lake,
Indian Yellow,
Mars Yellow,
Neutral Orange,
Purple Lake,
Roman Sepia,
Reuben's Madder,
Scarlet Lake,
Scarlet Vermilion,
Sepia,
Warm Sepia.

864. Whole cakes or pan, 65 cents each; half cakes or pan, 35 cents each.

Cobalt Blue,
Orange Vermilion,
Violet Carmine.

865. Whole cakes or pan, 90 cents each; half cakes or pan, 45 cents each.

Aureolin,
Burnt Carmine,
Cadmium Yellow,
Cadmium Orange,
Carmine,
French Blue,
Gallstone,
Green Oxide of Cromium,
Indian Purple,
Intense Blue,
Lemon Yellow,
Pale Cadmium Yellow,
Pink Madder,
Pure Scarlet,
Rose Madder,
Viridian.

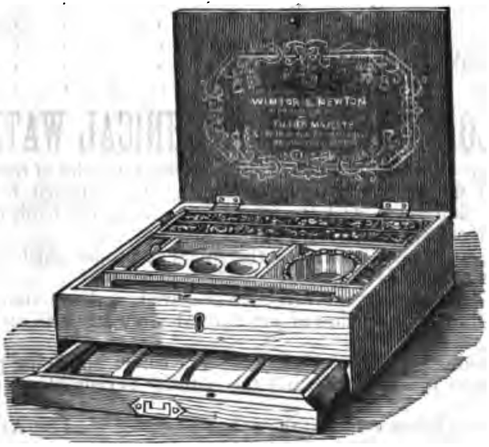
866. Whole cakes or pan, $1.40 each; half cakes or pan, 70 cents each.

*Field's Orange Vermilion,
*Madder Carmine,
Mars Orange,
Purple Madder,
Smalt,
Ultramarine Ash.

Genuine Ultramarine, ¼ cakes, each $2.25. Pure Gold, in cakes, $2.50; in cups, 25 cents; in shells, 20 cents.

Colors not made in pans are marked *.

WINSOR & NEWTON'S WATER COLOR BOXES, Complete.



867.

No.		Whole cakes. PRICE.	Half cakes. PRICE.
867—1.	Polished Mahogany Box, with lock and key and drawer, paint-stone, water-glass, India-ink, brushes, and 12 colors,	$12.00	
867—2.	Do. do. do. do. do. 18 do.	16.00	$12.00
867—3.	Do. do. do. do. do. 24 do.	20.00	15.00
868—1.	Polished Mahogany Box, with sliding lid and 12 do.	5.00	3.00
868—2.	Do. do. do. do. 18 do.	7.50	4.25
869—1.	Empty Mahogany Color Boxes, for 12 colors, ...	.60	.50
869—2.	Do. do. do. do. 18 do.	.75	.60
869—3.	Do. do. do. do. 24 do.	1.00	.75

WINSOR & NEWTON'S WATER COLORS.

LIQUIDS, IN GLASS BOTTLES.

Liquid Indian Ink.
Prepared by
WINSOR & NEWTON
38 Rathbone Place, London.

870—F.

No.		Price.
870—A.	Carmine,	$0.45
B.	Indelible Brown Ink,	.45
C.	Prout's Brown,	.45
D.	Gold Ink,	.65
E.	Extract of Ox Gall,	.35
F.	Indian Ink,	.35
G.	Chinese White,	.35
H.	Sepia,	.45
I.	Silver Ink,	.40
J.	Ox Gall, prepared in pots,	.20
K.	Pure Gold, in cakes,	2.00
L.	Do. in cups,	.25
M.	Do. in shells,	.20
N.	Silver Cakes, in cups,	.35
O.	Do. in shells,	.15

QUEEN & CO.'S STANDARD TECHNICAL WATER COLORS.

After many experiments, we have at last perfected a series of technical colors that we believe will meet a want long felt among draughtsmen for a ready-mixed standard color of fine grade, suitable for all branches of mechanical drawing.

The advantages we claim for these colors are:

1. All time usually spent in mixing the colors to proper shade is saved, and uniformity in tint is invariably produced.

2. The colors have been very carefully prepared, and are standard, such being universally used in all branches of mechanical drawing both in Europe and the United States.

3. They are made of the finest quality of water colors, and being put in moist form in pans, are always ready for use, and the liability to crumble of the cake colors is avoided.

The set described below contains the colors generally used by Architects, Machinists, Civil and Mechanical Engineers.

No.		Whole Pan. Each.	Half Pan. Each.	No.		Whole Pan. Each.	Half Pan. Each.
1.	Copper,	$0.40	$0.25	9.	Lamp Black,	$0.25	$0.15
2.	Brass,	.40	.25	10.	Machinery Green,	.40	.25
3.	Steel,	.40	.25	11.	Vermilion,	.25	.15
4.	Wrought-iron,	.40	.25	12.	Leather,	.40	.25
5.	Cast-iron,	.40	.25	13.	Prussian Blue,	.25	.15
6.	Brick,	.40	.25	14.	Carmine,	1.15	.60
7.	Stone,	.40	.25	15.	Chinese White,	.25	.15
8.	Wood,	.40	.25				

Set complete in Japanned Tin Box, 15 full pans,	7.50
Do. do. do. half do.	5.00

LIST OF COLORS.

Universally used in all branches of mechanical draughting, both in Europe and the United States.

1. Copper.
2. Brass.
3. Steel.
4. Wrought-iron.
5. Cast-iron.
6. Brick.
7. Stone.
8. Wood.
9. Lamp Black.
10. Machinery Green.
11. Vermilion.
12. Leather.
13. Prussian Blue.
14. Carmine.
15. Chinese White.

Nos. 1 to 8 to be diluted as may be required for light and dark shadows on machinery, stone, brick, wood, etc.

No. 9 may also be used for ink lines, the same as India Ink.

No. 10 color used in painting machinery, to obviate both rust and cleaning.

NOTE.—All designed fractures or cross-sectional parts of steel, copper, wrought-iron, cast-iron, stone, brick, wood, etc., may be shown by a lighter or darker tint than that in which it is colored, or by consecutive parallel lines of same color.

"Standard Colors." THEO. P. V. FAY,
Chief Draughtsman to the P. & R. R.

QUEEN'S COLORED INKS.

JAS. W. QUEEN & CO.
LIQUID BLUE.
PHILA.

871.

872.

872½.

No.		Price.
871.	Liquid Blue, per bottle,	$0.25
	Do. Green, per bottle,	.25
	Do. Carmine, per bottle,	.50

These Inks are especially recommended, being the only good liquid blue and green colors now in the market. The blue, especially, is very superior, being very brilliant and permanent.

DEPARTMENT OF SURVEYS. REGISTRY BUREAU,
City Hall, Broad and Market Streets, E. Entrance,
April 23d, 1880.

JAMES W. QUEEN & CO.:

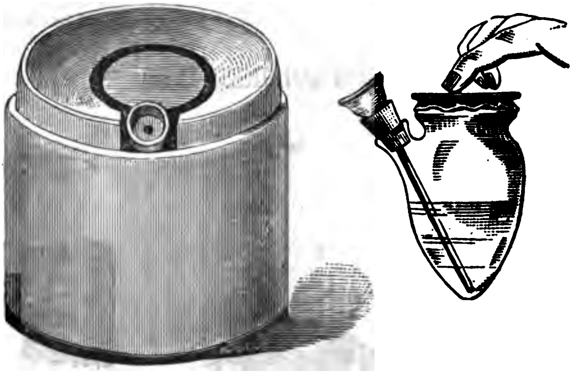
GENTLEMEN: The Inks supplied by your house to our office have given perfect satisfaction, and I cheerfully recommend them as being the only good colored Inks for draughting purposes I have ever been able to procure; they flow freely, and are very brilliant in color. Yours, very truly,

JOHN H. DYE, Registrar.

HIGGINS' AMERICAN DRAWING INKS.

No.		Price.
872.	No. 1.—General Drawing Ink, which is suitable for all general drawing, whether lines or tints, or for pen or brush work. This quality is almost identical with the finer kinds of India ink, but is much preferable, in being already fluid and in being finer and blacker. Per bottle, ...	$0.25
	No. 2.—Waterproof Drawing Ink. This ink is best for all working, architectural, map, or other drawing designed to stand moisture, rough handling, or washing over with colors. *Lines drawn with this ink will resist washing immediately after drying.* It is not recommended for brush shading, but for lining or solid black work is superb. It is the best ink for Whatman's or other hard papers, on which it flows freely, giving fine solid black lines. Per bottle, .	.25
872½.	Featherstone's Architectural Drawing Ink. This is an imported ink, and is claimed to be especially suitable for Photo-Lithography. Per bottle, ...	.50

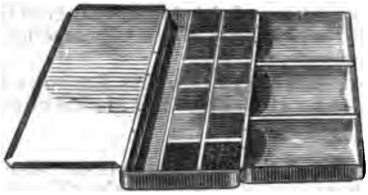
AUTOMATIC INK CUPS.



873.	Single bottle, in box, with lid, ...	1.25
	Triple do. do. do.	1.75

These Cups are intended to hold Water Colors or India Ink in a liquid state. The cup being hermetically sealed, there is no evaporation. The ink is always ready, and can be used up entirely. After grinding or dissolving a sufficient quantity to about half fill the cup, the ink is placed in by removing the small tubes. Replace tube, and by a slight pressure of the finger on the rubber top the color is forced up into the mouthpiece and the pen or brush filled. On removing the pressure, the contents return to the cup. It saves the waste of color caused by drying or scaling, and the time consumed in mixing whenever ink is needed.

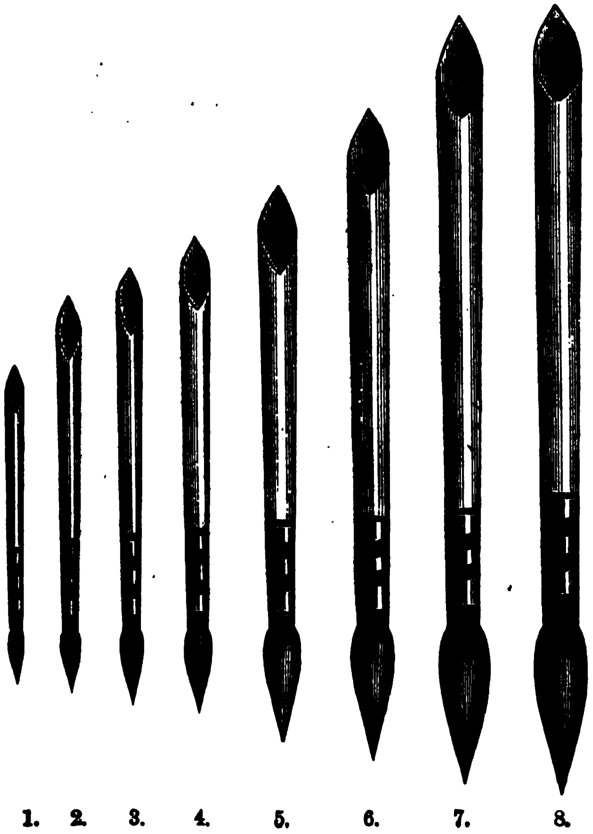
EMPTY JAPANNED TIN BOXES FOR MOIST COLORS.



874. Empty Japanned Tin Boxes for Moist Colors, in Pans.

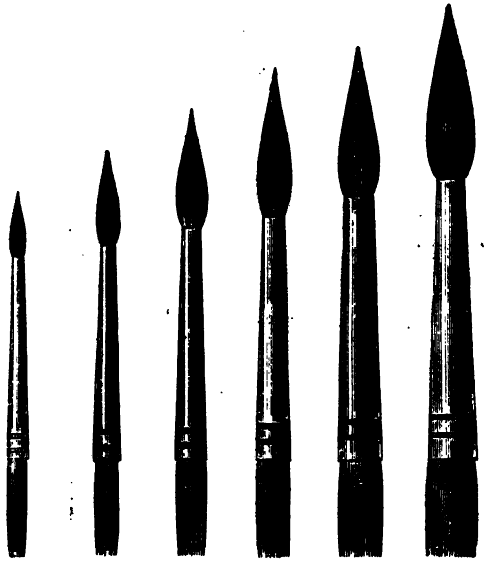
	For 6 full or 12 half-pans, each, ...	$1.25
	For 12 do. 24 do. do.	1.50
	For 16 do. 32 do. do.	2.50
	For 24 do. 48 do. do.	3.00

CAMEL'S-HAIR AND SABLE BRUSHES.



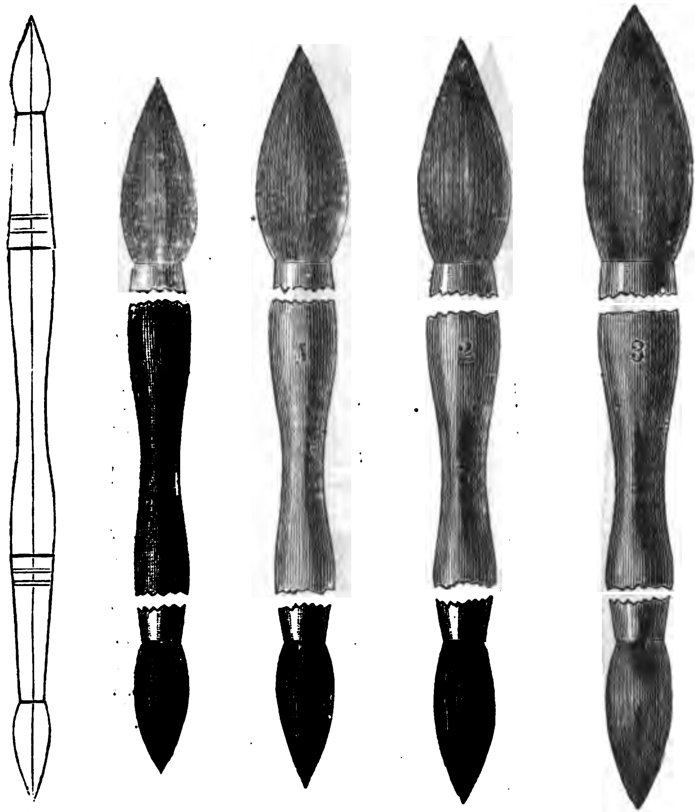
877 (FULL SIZE).

No.		PRICE
877.	Camel's-hair Pencils, fine quality, in quills,	
	Nos. 1 and 2, each,	$0.05
	Nos. 3 and 4, each,	.06
	Nos. 5 and 6, each,	.08
	Nos. 7 and 8, each,	.10



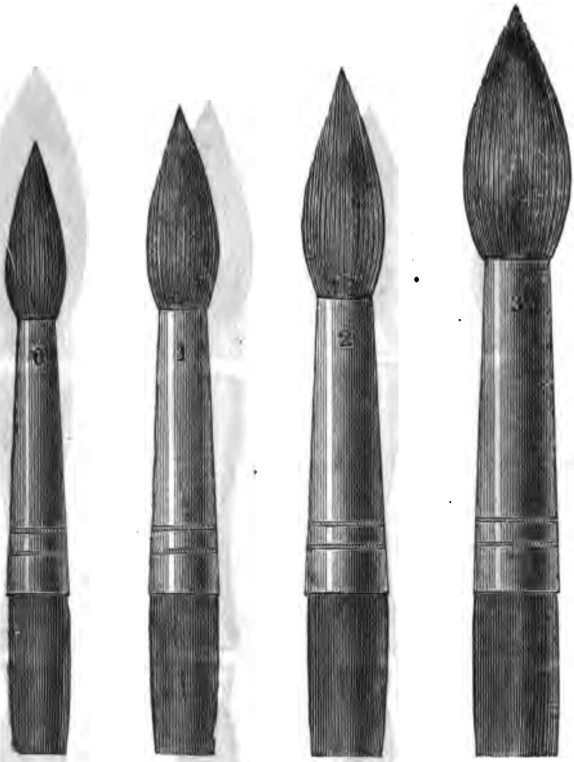
878 (Full Size).

No.		Price.
878.	Camel's-hair Pencils, fine quality, wood handles, metal tubes.	
	Nos. 1 and 2, each,	$0.10
	Nos. 3 and 4, each,	.12
	Nos. 5 and 6, each,	.15



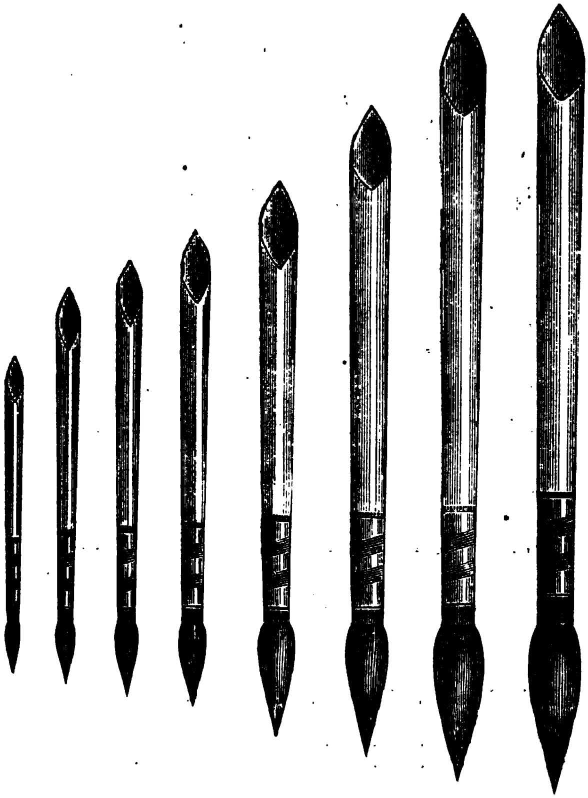
879 (Full Size).

No.		Price.
879.	Double Camel's-hair Wash Pencils, fine quality, metal tubes, wood handles.	
	Nos. 0, each,	$0.40
	Nos. 1, each,	.50
	Nos. 2, each,	.60
	Nos. 3, each,	.75



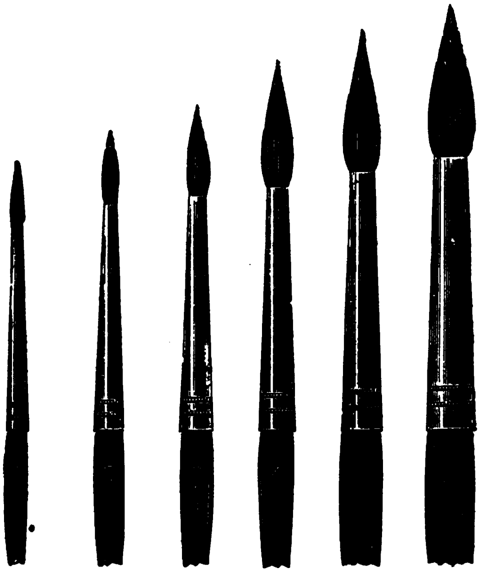
879½ (FULL SIZE).

No.		PRICE.
879½.	Single Camel's-hair Wash Pencils, same quality and sizes as No. 879.	
	Nos. 0, each,	$0.20
	Nos. 1, each,	.30
	Nos. 2, each,	.35
	Nos. 3, each,	.45
880.	Large Camel's-hair Pencils and Swan Quill, fine quality.	
	Nos. 1 and 2, each,	.25
	Nos. 3 and 4, each,	.40
	Nos. 5 and 6, each,	.60



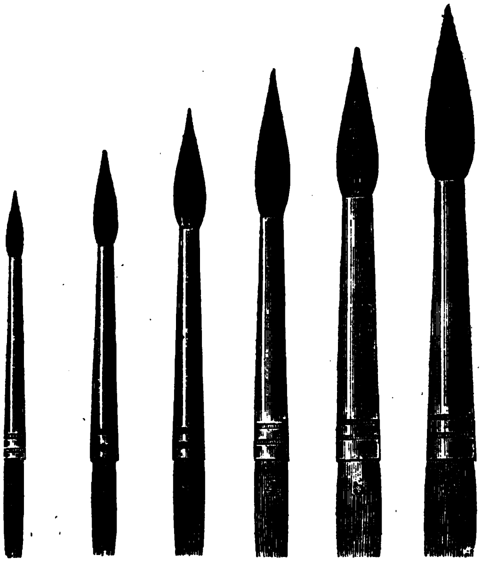
881 (Full Size).

No.		Price.
881.	Red Sable Hair Pencils, in Quills.	
	Nos. 1 and 2, each,	$0.25
	Nos. 3 and 4, each,	.30
	Nos. 5 and 6, each,	.40
	Nos. 7 and 8, each.	.75



882.

No.		Price.
882.	Red Sable Hair Pencils, with black wood handles.	
	Nos. 1 and 2, each,	$0.25
	Nos. 3 and 4, each,	.40
	Nos. 5 and 6, each,	.70
882½.	Large Red Sable Hair Pencils in Swan Quills, fine quality.	
	No. 0,	2.50
	No. 1,	2.25
	No. 2,	2.00
	No. 3,	1.50
	No. 4,	1.00
	No. 5,	.75



883.

No.		Price.
883.	Brown Sable Hair Pencils, with black wood handles, fine quality.	
	Nos. 1 and 2, each,	$0.30
	Nos. 3 and 4, each,	.45
	Nos. 5 and 6, each,	.80
883½.	Large Brown Sable Hair Pencils, in Swan Quills, fine quality.	
	Nos. 0, each,	3.00
	Nos. 1, each,	2.50
	Nos. 2, each,	2.00
	Nos. 3, each,	1.50
	Nos. 4, each,	1.00

900.

901.

902.

903.

904.

905.

INDIA INK.

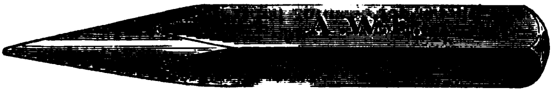
No.		PRICE.
900.	India Ink, sticks, four-sided black, gilt, 2 inches long, each, . .	$0.10
901.	Do. do. round, lion's head, gilt, 2½ inches long, each, . .	.25
902.	Do. do. do. do. 4 inches long, each, . . .	.75
903.	Do. do. oval, do. 3 do. do. . . .	.40
904.	Do. very superior, sticks, 3¾ by ¾ by ⅝ inches, do. . . .	1.50
904½.	Do. same quality as 904, sticks 3¾ by ⅝ by ⅝ inches, each, . .	.75
905.	Do. Winsor & Newton's best sticks, square, 3½ inches long, each,	2.00
905—A.	Pearl, very fine, per cake, ...	3.00
B.	Gilt, extra quality, per cake, ...	4.00
C.	India Blue (Ultramarine), ...	.75
D.	India Reddish Brown (Bt. Sienna), ...	.75
E.	India Yellow (Chrome), ...	.75
F.	India Red (Vermilion), ...	.75
G.	India Lake (Crimson), ...	1.00
905½—A.	Japanese India Ink, oblong, 3¾x¾ inch, per cake, ...	1 00
B.	Do. do. extra large, fine quality, ...	3.00

The Chinese Inks are most suitable for general draughting. The Japanese, only for those drawings in which the ink-lines are frequently washed in applying water colors.

INDIA RUBBER.

906

No.					Price.
906—A.	A. W. Faber's, first quality,	1⅛x⅞	inches,	each,	$0.05
B.	Do. do.	1½x1	do.	do.	.06
C.	Do. do.	1¾x1¼	do.	do.	.12
D.	Do. do.	2 x1⅜	do.	do.	.20
E.	Do. do.	3 x2⅛	do.	do.	.50

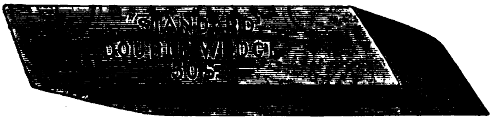


906 F.

F.	A. W. Faber's Pointed Rubber,	3 x ⅝	inches,	each,	.15
G.	Do. do.	$2\frac{1}{2}$x$\frac{5}{16}$	do.	do.	.10

907.

907—A.	Davidson's Velvet Rubber, oblong,	1 x$\frac{7}{16}$	inch.	each,	.05
B.	Do. do. do.	2⅜x½	do.	do.	.12
C	Do. do. do.	3¼x⅝	do.	do.	.20
908.	Standard Single Wedge, do.	2¾x½	do.	do.	.15



909 C.

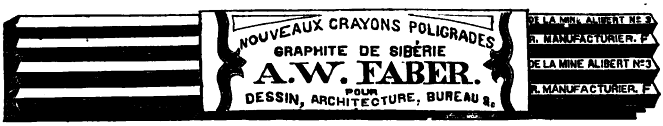
909—A.	Standard Double Wedge, oblong,	1¾x¾	inches,	each,	.05
B.	Do. do. do.	2¾x¾	do.	do.	.15
C.	Do. do. do.	3 x1	do.	do.	.20
910—A.	Faber's Black, Pure Gum,	2 x1⅜	do.	do.	.20
B.	Do. do. do.	2⅝x1⅝	do.	do.	.35

912.

912½.

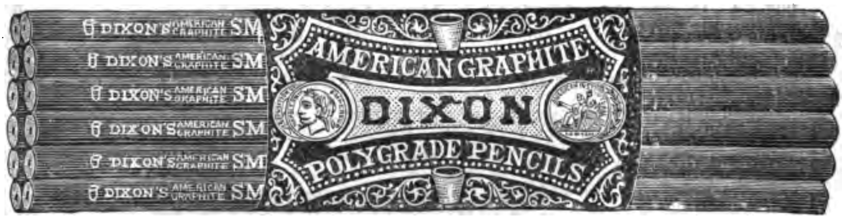
No.		PRICE.
912—A.	A. W. Faber's Combined Ink and Pencil Eraser, small, each,	$0.20
B.	Do. do. do. large, do.	.30
912½.	A. W. Faber's Improved Ink Eraser, small, 5 cents; large,	.10
912¾—A.	Sponge Rubber, for cleaning paper, pieces 1x1x¾, do.	.10
B.	Do. do. 2½x1¾x½, do.	.40
C.	Do. do. 4x2x1, do.	.75

LEAD PENCILS.



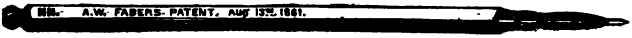
914.

913.	A. W. Faber's Hexagonal gilt, Nos. 1, 2, 3, 4, 5, per dozen,	.75
914.	Do. Pure Siberian Lead, Nos. BBBBBB, BBB, BB, B, HB, F,H, HH, HHH, HHHHHH, very superior, 15 cents each, per dozen.	1.25



914½.

914½.	American Lead Pencils, Grade S, SM, M, H, VH, for general drawing,	.60
915.	A. W. Faber's small, round, for Divider Points, per dozen,	.75
917.	Red, Green, Blue, and Yellow Pencils, do.	1.25
918.	J. W. Guttknecht's Pencils, Red at one end, Blue at the other, per dozen,	1.25


A.W. FABERS. PATENT. Aug 13th 1861.

920.

No.		Price.
919.	Faber's Artists' Pencils, hexagonal, gilt, each,	$0.25
919½.	Do. do. 6 in a box, Nos. 1, 2, 4 or 5, per box,	.50

920½.

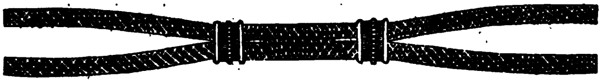
920.	Faber's Artists' Pencils, with Siberian Leads, each,	.35
920½.	Do. do. Leads, 6 in a box, Nos. 4B to 6H, per box,	.65

The Leads of Nos. 919½ and 920½ will fit the new pencil-holders in Alteneder and Swiss sets, No. 284, etc. Each box has only one grade of leads.

920¾—A.	Faber's Round Pencils, 5 in a box, per box,	.50
B.	Do. do. 7 in a box, do.	.65
C.	Do. Hexagon, gilt, 5 in a box, do.	.90
D.	Do. do. do. 7 in a box, do.	1.20
921—A.	Red Chalk Pencils, for marking stakes, best quality, per dozen,	1.25
B.	Do. do. in cedar, per dozen,	.75
C.	Do. Crayons, superior quality, per dozen,	.60
D.	Do. in lumps, per pound,	.30

CRAYONS.

922—A.	Black Conté Crayons, square, black, Nos. 1, 2 or 3, per dozen,	.20
B.	Do. do. in wood, Nos. 1 or 2, do.	.60
C.	Do. do. do. No. 3, do.	.90
D.	White, in wood, per dozen,	.60
E.	Faber's Wax Crayons, in cedar wood, assorted colors, in boxes; 6, 12, 18, 24, 36 colors, each,	.75, $1.50, $2.00, $2.50, $3.25



923—A.	Brass Crayon Holders, 4, 5 or 6 inch, each,	.07
B.	German Silver do. 4, 5 or 6 do. do.	.10
924.	Paper Stumps, assorted sizes, each,	.05

SOENNECKEN'S ROUND WRITING PEN.

925.	Single-pointed Pens, assorted, per gross, $1.10; per dozen,	.20
A.	Double-pointed Pens, assorted, per dozen,	.50
B.	Copy Book, without instructions,	.60
C.	Text Book for Round Writing, giving full instructions,	1.10
	Sample assortment of Pens, 25 in a box,	.35

No.		Price.
926.	Gillott's Mapping Pen, on cards, with holder, per gross, $6.00; per dozen,	$0.75
	A. Gillott's Lithographic Crow-quill Pens, on cards, with holder, per gross, $6.00; per dozen,	.75
	B. Gillott's Lithographic Pens, per gross, $5.00; per dozen,	.75
	C. Do. No. 170 Pen, per gross, $1.25; do.	.15
	D. Do. No. 303 Lettering Pen, per gross, $1.50; per dozen,	.20
	E. Do. No. 104 do. do. 1.25; do.	.20
	F. Esterbrook's Engraving Pens, per gross, 1.00; do.	.20
	G. Do. Falcon Pen, do. .75; do.	.15
	H. Do. Commercial Pen, do. .75; do.	.15

MISCELLANEOUS STATIONERY.

No.		Price.
927.	Rogers' Steel-blade Eraser, cocoa handles, each,	.60
	A. Do. do. do. with ivory handle,	.75
	B. Do. do. do. with ebony do. double-edged, combining knife and eraser,	1.00
	Best Foolscap Paper, 7¾x12¼ inches, per ream, $5.00; per quire,	.35
	Best Letter Paper, 8x10 inches, do. 4.50; do.	.30
	Best Commercial Note, 5x8 inches, do. 2.75; do.	.20
	Superior Post-office Paper, buff tint, do. 7.50; do.	.50
	Best Flat Paper, smooth, suitable for sensitizing:	
	Demy, 16x21 inches, per ream, $9.50, per quire,	.60
	Medium, 18x23 do. do. 15.00, do.	.90
	Royal 19x24 do. do. 17.00, do.	1.00
	Superroyal, 20x28 do. do. 24.00, do.	1.40
	Imperial, 23x31 do. do. 30.00, do.	1.65
	Elephant, 23x38 do. do. 32.00, do.	1.75
	Double Elephant, 27x40 do. do. 60.00, do.	4.00
	Antiquarian, 31x53 do. do. 125.00, do.	7.50
	Superior White Envelopes, letter size, per 1,000,	4.00
	Do. Buff do. do. do.	3.50
	Do. do. do. Legal, letter size, per 1,000,	7.00
	Arnold's Writing Ink, per quart,	.75
	Do. Copying do. do.	1.25
	David's Carmine, in 2-ounce bottles, glass stopper, per bottle,	.50
	Copying Book, letter size, each,	2.50
	Mucilage, per quart, $1.25; per cone (3 ounce),	.25
	Rubber Bands, ¼ inch wide, 2 inches long, per gross, $0.90; per dozen,	.12
	Do. ¼ do. 2½ do. do. 1.15; do.	.15
	Do. ¼ do. 3 do. do. 1.35; do.	.20
	Do. ¼ do. 3½ do. do. 1.50; do.	.25
	Do. ½ do. 2 do. do. 1.75; do.	.25
	Do. ½ do. 2½ do. do. 2.00; do.	.30
	Do. ½ do. 3 do. do. 2.25; do.	.35
	Do. ½ do. 3½ do. do. 2.50; do.	.40
	Do. ½ do. assorted lengths, do. 2.00.	
	Do. $\frac{1}{16}$ do. 1¼ inches long, for tickets, etc., per gross,	.25

All other sizes Rubber Bands furnished at proportional rates.

	Price.
Sand-paper Tablets, for pointing pencils, No. 1 Medium, No. 2 Rough, each,	.15
Files, mounted on blocks, No. 1, No. 2, each,	.25
Arkansas Oil Stones, from 25 cents to $2.00 each.	
Do. do. in cases, from $1.00 to $2.50 each.	

SOLID SKETCH BLOCKS.

Each Block consists of 32 leaves of best quality Whatman's Drawing Paper.

						PRICE.
16mo	Royal,	4½x 6,	unbound,	$0.65	*bound,	$1.25
8vo	do.	6 x 9,	do.	1.00	do.	1.85
4to	do.	9 x12,	do.	1.75	do.	3.00
Half	do.	12 x18,	do.	3 00	do.	4.50
32mo	Imperial,	3½x 5½,	do.	.55	do.	1.00
16mo	do.	5½x 7,	do.	.80	do.	1.50
8vo	do.	7 x10,	do.	1 40	do.	2.50
4to	do.	10 x14,	do.	2.50	do.	3.75
Half	do.	14 x20,	do.	4.25	do.	6.00

* The binding has Cloth Sides and Leather Back, with a Portfolio and Loop for Pencil inside. The Portfolio will last for a number of blocks.

INDUSTRIAL DRAWING COPIES

for Mechanics and Students in Industrial Evening Schools. Prepared, under the superintendence of Prof. Walter Smith, by James E. Stone.

24 large Folio Plates, as below, unmounted, per set,	6.00
Do. do. do. mounted, do.	15.00

ISOMETRIC PROJECTIONS.

PLATE 1. Angular Bodies, mounted on pasteboard,	.75
Do. 2. Curved Surfaces and Bodies,	.75

CARPENTRY.

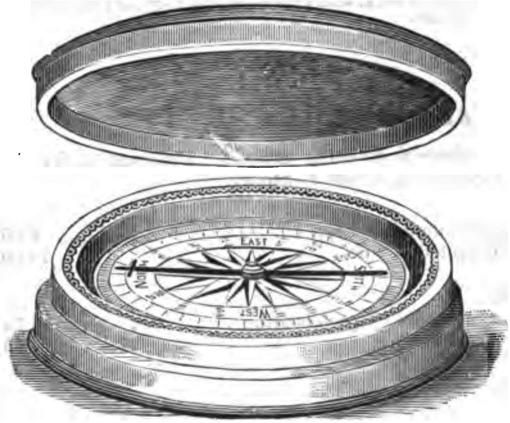
PLATE 1. Framing,	.75
Do. 2. Framing for Front and Side Elevation,	.75
Do. 3. Framing,	.75
Do. 4. Details of Framing,	.75
Do. 5. Details of Framing,	.75
Do. 6. Details of Roof,	.75
Do. 7. Details of a Door,	.75
Do. 8. Joints,	.75

MACHINERY.

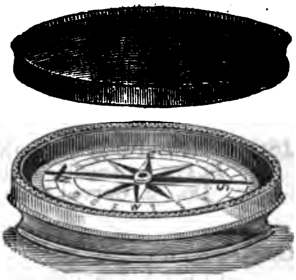
PLATE 1. Screws, Bolts, and Nuts,	.75
Do. 2. Theory of Screws and Tops of Bolt Heads,	.75
Do. 3. Stub End,	.75
Do. 4. Pillow-block,	.75
Do. 5. Eccentric and Shaft and Eccentric Strap,	.75
Do. 6. Wrench,	.75
Do. 7. Vise,	.75
Do. 8. Faucet and Hand Punch,	75
Do. 9. Spur Gear,	.75
Do. 10. Approximate Method of Drawing Spur Gear,	.75
Do. 11. Bevel Gear,	.75
Do. 12. Plan of a Steam-engine,	.75
Do. 13. Elevation of Steam-engine,	.75
Do. 14. Details of Steam-engine,	75
Price per plate, unmounted,	.35

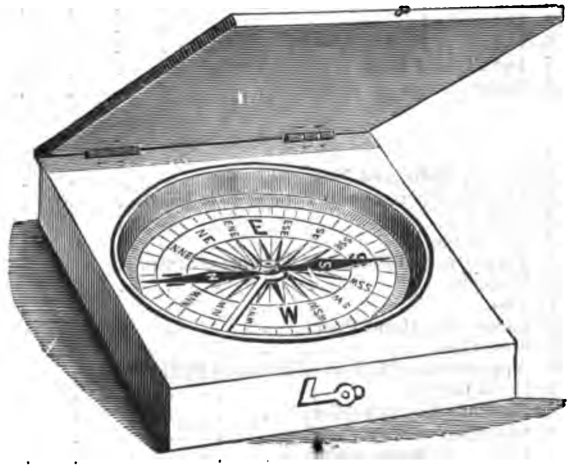
CHAPTER XI.

POCKET COMPASSES.

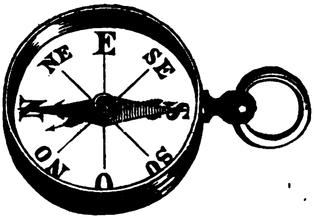


930.

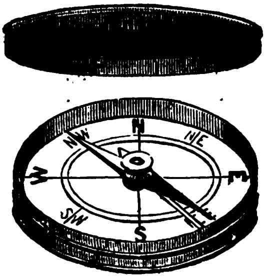




933.

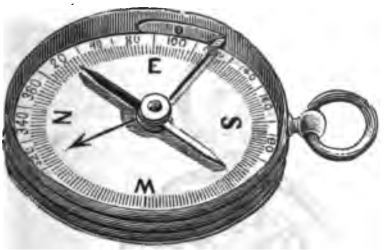


931.

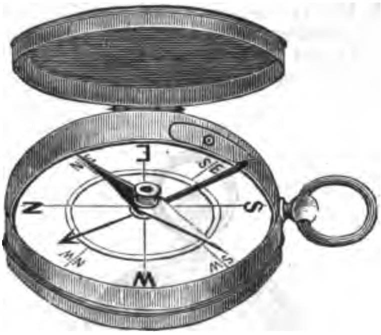


937*a*.

No.		PRICE.
930.	Pocket Compass, round wood case, no stop to needle, ...	$0.50
931.	Do. brass, round, 1½ inches in diameter, with cover, no stop to needle, ...	.50
932*a*.	Pocket Compass, watch pattern, brass, 1 inch diameter, no stop to needle, ...	.50
932*b*.	Same as above, but 1½ inches in diameter, ...	.65
932*c*.	Do. do. but 1 do. do. and stop to needle, . .	.65
932*d*.	Do. do. but 1½ do. do. do. do. . .	.90
933.	Pocket Compass, mahogany case, 1½ inches square, with stop to needle,	1.50
934.	Do. same as 933, 2 inches square, ...	2.00
935.	Do. do. 2½ do.	2.25
936.	Do. do. 3 do.	2.75
937*a*.	Do. brass, round, with cover, 1½ inches diameter, with stop to needle, ...	1.25
937*b*.	Pocket Compass, same as 937*a*, but with agate centre to needle, . .	1.75



943*a*.



945*a*.

943*a*.	Pocket Compass, of brass, round, 1½ inches diameter, with stop and agate centre to needle, ...	1.25
943*b*.	Pocket Compass, same as 943*a*, but nickel-plated, ...	1.50
944*a*.	Do. watch pattern, brass, 2 inches diameter, with stop and agate centre to needle, ...	1.50
944*b*.	Pocket Compass, same as 944*a*, but nickel-plated, ...	1.75
945*a*.	Do. do. brass, 1½ inches diameter, with hinged cover, stop and agate centre to needle, ...	1.75

No.		Price.
945*b*.	Pocket Compass, same as 945*a*, but nickel-plated, ...	$2.00
945*c*.	Do. do. but German silver, ...	2.50
945*d*.	Do. do. but 2 inches diameter, with nickel-plated case, ...	2.50

946*a*.

947*a*.

946*a*.	Pocket Compass, watch pattern, nickel-plated hunting case, bar needle, 1½ inches in diameter, raised ring, metal face, ...	4.00
946*b*.	Pocket Compass, watch pattern, nickel-plated, but 1¾ inches in diameter, ...	4.50
947*a*.	Pocket Compass, nickel-plated hunting case, raised ring, stop to needle, folding sights, 2 inches in diameter, ...	4.25
947*b*.	Pocket Compass, nickel-plated hunting case, raised ring, stop to needle, folding sights, but 2¾ inches in diameter, ...	7.00
947*c*.	Pocket Compass, nickel-plated hunting case, raised ring, stop to needle, folding sights, with levels, ...	8.00

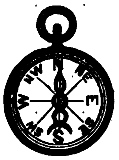
948*a*.

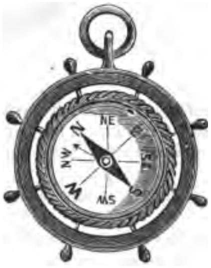
949*a*.

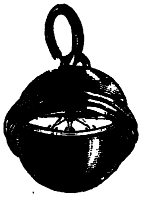
948*a*.	Pocket Compass, watch pattern, gilt, enameled or metal face, stem stop. Bar needle, 1¼ inches in diameter, ...	5.00

No.		Price.
948*b*.	Pocket Compass, same as 948*a*, but 1½ inches in diameter, . . .	$6.00
948*c*.	Do. do. but 1¾ do. do. . . .	7.00
948*d*.	Do. nickel-plated or gilt case, with hinged cover, spring catch and stop to needle in joint of cover, ...	3.75
948*e*.	Bar Needle, nickel-plated or gilt case, with hinged cover, spring catch and stop to needle in joint of cover, 2 inches in diameter, . .	5.00
949*a*.	Pocket Compass, watch pattern, gilt, stem stop, in case, 1¼ inches diameter, Singer's patent pearl dial, ...	5.50
949*b*.	Pocket Compass, watch pattern, gilt, stem stop, in case, 1½ inches diameter, Singer's patent pearl dial, ...	6 00
949*c*.	Pocket Compass, watch pattern, gilt, stem stop, in case, 1¾ inches diameter, Singer's patent pearl dial, ...	6.50

CHARM COMPASSES.


950*a*.


950*b*.


950*d*.

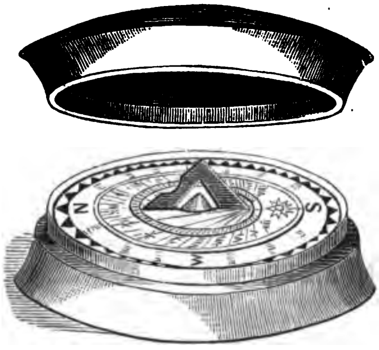
950*a*.	Gilt, round, ½ inch, ...	.25
950*b*.	Do. 1 do.	.50
950*c*.	Gilt band, with glass on each side, ¾ inch, ...	1.50
950*d*.	Nickel-plated, gimbal mounted; small, $2.00; medium, $2.25; large,	2.50
950*e*.	Gold, round case, engraved back, ½ inch in diameter, ...	3.50
950*f*.	Gold, round case, engraved or stone back, ¾ inch diameter, . . .	5.00
950*g*.	Gold, anchor pattern, ¾ inch diameter, ...	7.50
950*h*.	Gold, plain band, pebble compass, ¾ inch diameter, each, . . .	10.00

BOAT COMPASSES.

Boat Compass, floating card dial, double gimbal mounting, nickel-plated case with cover.

1¾ inch diameter, ...	4.25
3 inches diameter, ...	6.00
4½ inches diameter, ...	14.00

SUN-DIAL COMPASSES.

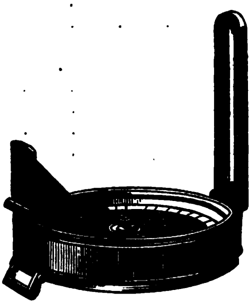


952.

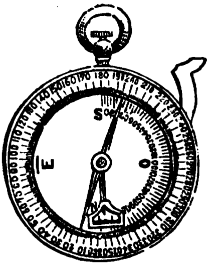
955.

No.		Price.
952.	Pocket Compass and Sun-dial, wood box, with cover, ...	$0.50
953.	Do. mahogany case, with Universal Sun-dial, . . .	8.00
954.	Do. brass, with levels and leveling screws, and Universal Sun-dial, ...	14.00
955.	Pocket Compass, brass, with hinged cover and Sun-dial, 2 inches diameter, ...	4.00
956.	Pocket Compass, brass, with hinged cover and Sun-dial, 2½ inches diameter, ...	5.50

Sun-dials, for lawn use, made to order for any latitude.



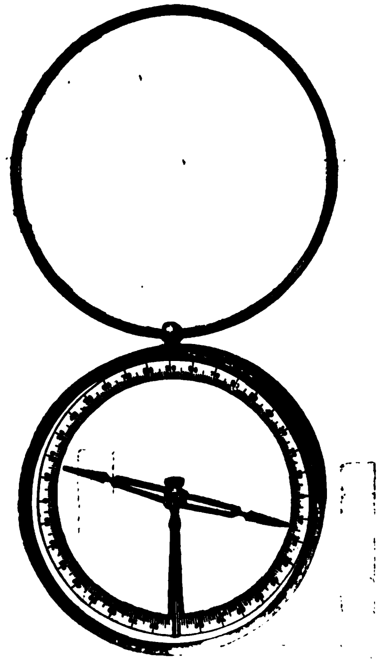
957.



959.

957.	Prismatic Azimuth Compass, of brass, 2¾ inches diameter, . . .	18.00
958.	Do. do. do. 4 do.	22.00
959.	Geological Compass, of brass, with pendulum for ascertaining the angle of dip in rocks, each, ...	4.50
960.	Geological Compass, same as No. 959, but made of German silver, .	5.50

961.



961½.

No.		Price.
961.	Miner's Compass, for tracing iron ore,	$12.00
961½.	Do. do. Norwegian Needle, glass both sides, with brass covers, 3-inch needle,	12.00
961¾.	Same as above, but with 4-inch needle,	15.00

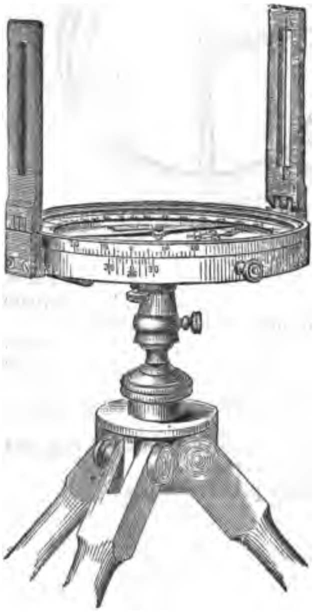
This consists essentially of a dipping-needle, about 2½ inches long, which inclines toward any mass of iron, and thus discovers its position.

When used for tracing ore, the observer should hold the ring in his hand, and keep the needle north and south, standing with his face to the west.

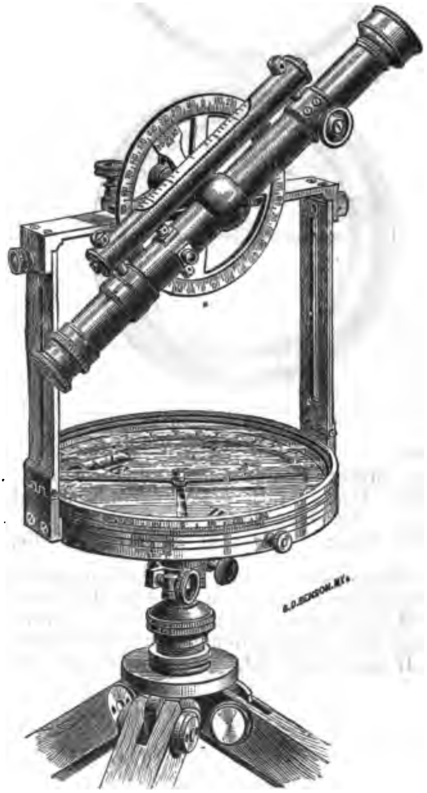
If held horizontal, it serves, of course, as an ordinary pocket compass.

CHAPTER XII.

SURVEYOR'S COMPASSES, TRANSITS, LEVELS, AND LEVELING RODS.



962, with Tripod.



965½.

No.		Price.
962.	Surveying Compass, with folding sights, needle 3½ inches long, nonius on side of compass, box for adding and subtracting magnetic variations, two straight levels, Jacob Staff mountings,	$16.00
962½	Same as above, but with 4½-inch needle,	18.00
963.	Surveying Compass, same as No. 962, but without nonius, needle 3½ inches long,	13.50

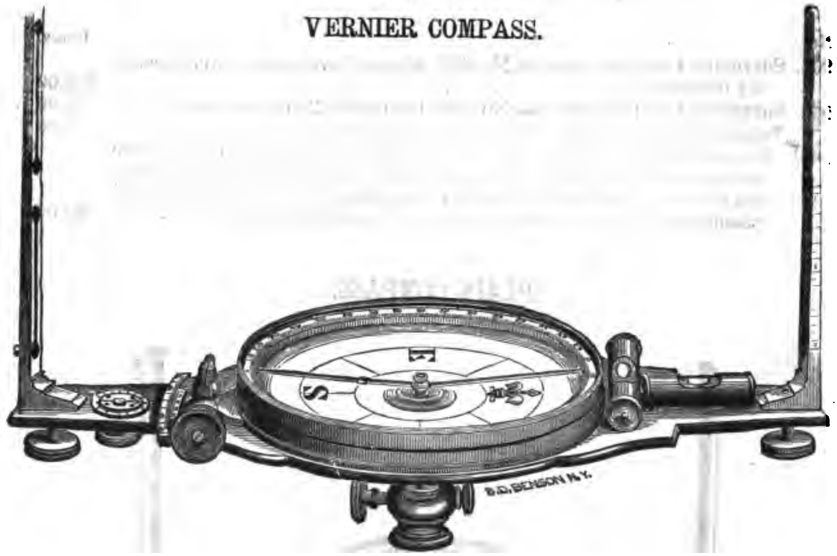
No.		PRICE.
964.	Surveying Compass, same as No. 962. without levels and nonius, needle 3½ inches long,	$12.00
965.	Surveying Compass, same as No. 964, but needle 2½ inches long,	10.00
	Tripod, with cherry legs, for any of above compasses,	7.00
965½	Vernier Pocket Compass, 4½-inch needle, with clamp and tangent to spindle, and fitted with Telescopic Sight No. 1, with extras of level on telescope, vertical circle with vernier reading to five minutes, and clamp and tangent to axis of telescope, including tripod,	55.00

PLAIN COMPASS.

966.

No.		PRICE.
966.	Surveying Compass, 4-inch needle, 12½-inch plate, two straight levels, Jacob Staff mountings, and sights graduated for taking angles of elevation and depression,	$25.00
967.	Surveying Compass, 5-inch needle, 15½-inch plate, two straight levels, outkeeper and Jacob Staff mountings, and sights graduated for taking angles of elevation and depression,	30.00
968.	Surveying Compass, 6 inch needle, 15½-inch plate, two straight levels, outkeeper and Jacob Staff mountings, and sights graduated for taking angles of elevation and depression,	35.00

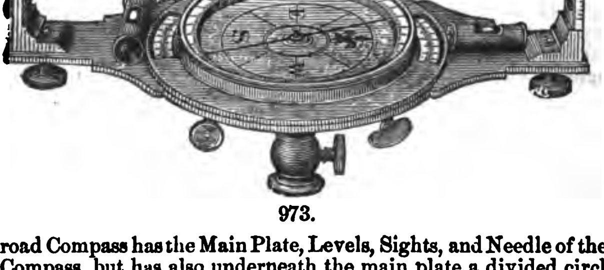
VERNIER COMPASS.



969.

No.		Price.
969.	Surveying Compass, 4-inch needle, 12½-inch plate, two straight levels, outkeeper and nonius for adding or subtracting the magnetic variations of the needle, and sights graduated for reading angles of elevation and depression, ...	$30.00
970.	Surveying Compass, same as No. 969, but with 5-inch needle and 15½-inch plate, ...	35.00
971.	Surveying Compass, same as No. 969, but has 6-inch needle and 15½-inch plate, ...	40.00

THE RAILROAD COMPASS.

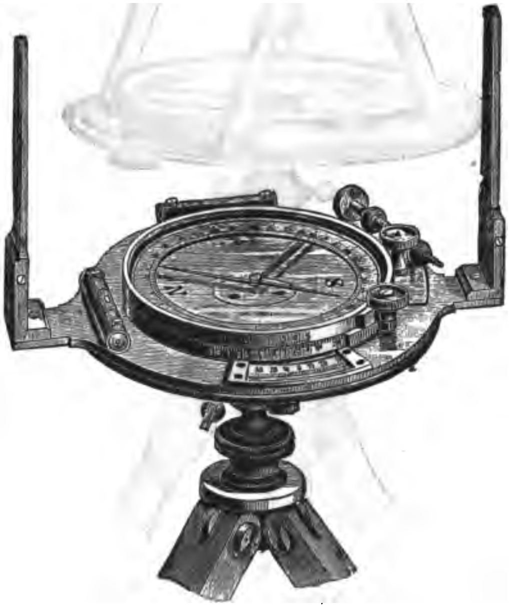


973.

The Railroad Compass has the Main Plate, Levels, Sights, and Needle of the ordinary Surveying Compass, but has also underneath the main plate a divided circle or limb by which horizontal angles to single minutes can be read independently of the needle.

973.	Railroad Compass, 5-inch needle and with one vernier to limb, and sights graduated to read angles of depression or elevations, ...	$60.00

No.		Price.
974.	Railroad Compass, 5½-inch needle, with one vernier to limb, and sights graduated to read angles of depression or elevation,	$60.00
975.	Same as No. 974, but with two verniers to limb,	75.00

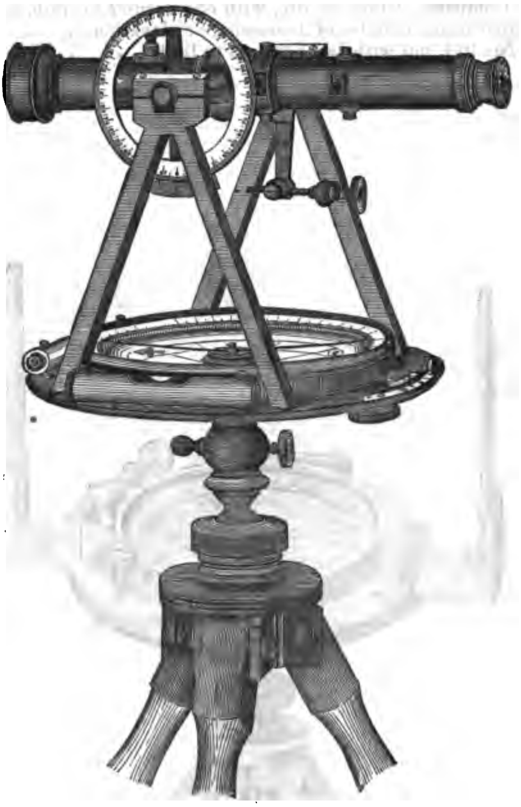


975½.

975½.	Railroad Compass, 4½-inch needle, clamp and tangent movement to limb, vernier reading to single minutes, complete with tripod,	45.00
976.	Tripod, with cherry legs, furnished to any of the compasses from Nos. 962 to 975,	7.00
977.	Tripod, with cherry legs, with parallel plates and leveling screws, and clamp and tangent movement, furnished to any of the compasses from 962 to 975,	18.00

All of the compasses are packed in handsome mahogany boxes.

VERNIER TRANSIT.



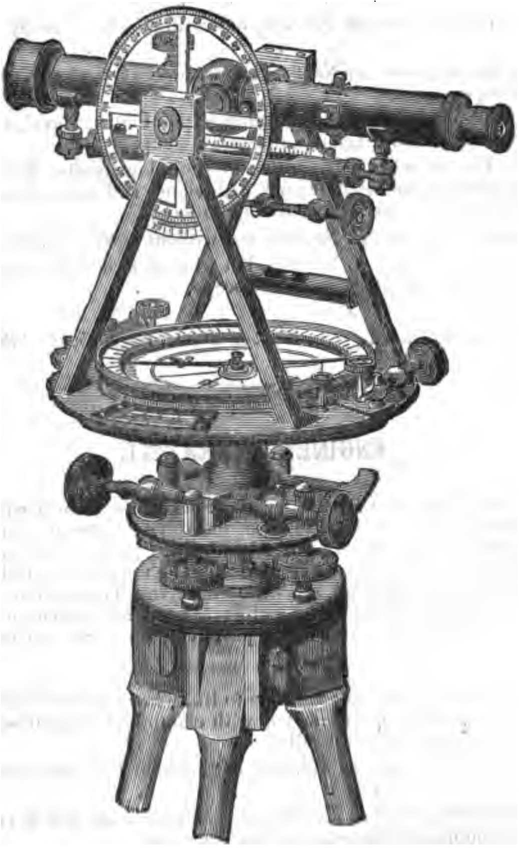
979.

The Vernier Transit, or Transit Compass, has the same general properties as the Vernier Compass No. 969, but is furnished with a telescope in place of the ordinary sights. The Telescope is from ten to twelve inches long, and sufficiently powerful to see and set a flag at a distance of two miles, in a clear day.

978.	Transit Compass, with needle 4 inches long, and light tripod, . . .	$70.00
979.	Transit Compass, same as No 978, but with vertical circle 3½ inches diameter and clamp and tangent movement to Telescope, . .	84 00
980.	Transit Compass, with needle 5 inches long and light tripod, . .	70.00
981.	Transit Compass, same as No. 980, but with vertical circle 3½ inches diameter and clamp and tangent movement to Telescope, . .	84.00

No.		PRICE.
982.	Transit Compass, with needle 6 inches and light tripod, ...	$75.00
983.	Transit Compass, same as No. 982, but with vertical circle and clamp and tangent movement to Telescope, ...	89.00
	Sights with folding joints on Telescope to either Transit Compass from 978 to 983	8.00
	Right Angle Sights on standards of either Transit Compass from 978 to 983,	8.00

SURVEYORS' TRANSITS.



985.

The Surveyor's Transit, as above illustrated, has a Telescope, from ten to twelve inches long, constructed with the finest lenses; under the telescope a level is attached for taking such levels as may occur in the practice of a surveyor. On one end of the axis of the telescope a divided circle, 4½ inches diameter, is attached for reading to minutes angles of elevation and depression. The rim of the compass box is divided to ½ degrees, and is provided with a nonius for adding and subtracting the magnetic variations of the needle. The limb on the divided circle outside the compass box, is provided with two verniers at right angles to the telescope and read to minutes. The tripod head is arranged with shifting centre, for setting the instruments quickly over a given point without the trouble of altering the position of the legs. The tripod legs are made of very strong mahogany.

No.		Price.
985.	Surveyor's Transit, with two verniers to limb, level under Telescope, vertical circle 4½ inches diameter, with clamp and tangent screw to axis of Telescope, needle 4 inches long,	$155.00
986.	Surveyor's Transit, same as No. 985, but without vertical circle to axis of Telescope,	143.00
987.	Surveyor's Transit, same as No. 985, but without level under Telescope and without vertical circle and clamp and tangent screw to axis of Telescope,	125.00
988.	Surveyor's Transit, same as No. 985, but with needle 5 or 5½ inches long,	160.00
989.	Surveyor's Transit, same as No. 988, but without vertical circle to axis of Telescope,	148.00
990.	Surveyor's Transit, same as No. 988, but without either level, vertical circle or clamp, and tangent screw to Telescope,	130.00
991.	Surveyor's Transit, with one vernier to limb, level under Telescope, vertical circle 4½ inches diameter, with clamp and tangent screw to axis of Telescope, needle 5 or 5½ inches long,	145.00
992.	Surveyor's Transit, same as No. 991, but without vertical circle,	133.00
993.	Surveyor's Transit, same as No. 991, but without either level, vertical or clamp, and tangent screw to Telescope,	115.00

The Surveyor's Transits, from No. 985 to 993, weigh about 13 lbs. each.

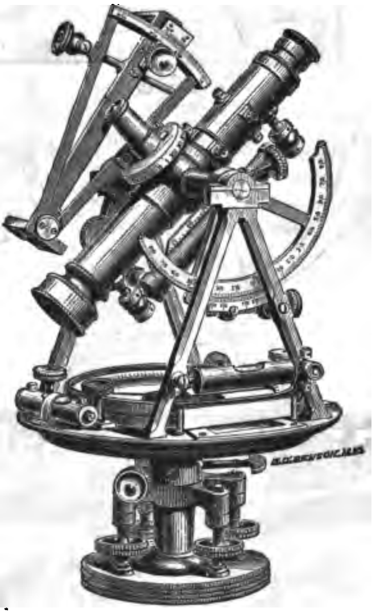
ENGINEER'S TRANSIT.

The description given on page 73 for the Surveyor's Transit will apply for the Engineer's Transit, excepting that the latter has the axis or centre running from the lower parallel plate of the tripod head to the centre plate of the instruments, thus securing greater accuracy for laying of angles. The upper part of the Transit does not separate from the tripod head, as in the Surveying Transit, but is permanently attached to the parallel plates and leveling screws, and when put in its box is unscrewed from the tripod at the lower parallel plate. See cut on first page of cover.

994.	Engineer's Transit, with two verniers to limb, level under Telescope, vertical circle 4½ inches diameter, with clamp and tangent screw to axis of Telescope, 4-inch needle,	$175.00
995.	Engineer's Transit, same as No. 994, but without vertical to axis of Telescope,	163.00
996.	Engineer's Transit, same as No. 994, but without either level, vertical circle or clamp and tangent screw to Telescope,	145.00
997.	Engineer's Transit, with two verniers to limb, level under Telescope, vertical circle and clamp and tangent screw to Telescope, needle 4½ or 5 inches long,	180.00
998.	Engineer's Transit, same as No. 997, but without vertical circle to axis of Telescope,	168.00
999.	Engineer's Transit, same as No. 997, but without either level under Telescope, vertical circle or clamp, and tangent screw to Telescope,	150.00

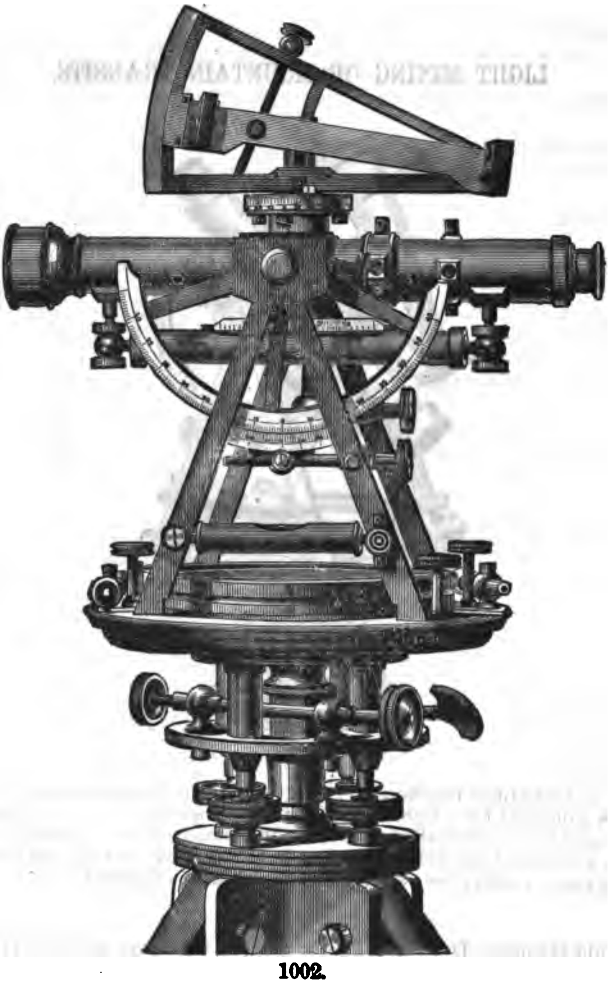
All the Transit Instruments from No. 978 to 999, inclusive, are furnished with handsome mahogany boxes.

LIGHT MINING OR MOUNTAIN TRANSITS.



This is an extra light Engineer's Transit, for mine or mountain use, introduced by us to meet a demand for a light transit of the best quality. It has met with a very large sale and been universally approved. We confidently recommend it to all our friends as a transit of the first class, capable of any work, and specially adapted for mining or rough country use, where great portability is required.

		PRICE.
No. 1.	Light Mountain Transit, with 4-inch needle, vernier for setting off the magnetic variation, two opposite verniers to the limb reading to single minutes; 8-inch achromatic telescope of the finest quality, power 20 diameters, furnished with our patent extension tripod, shortening to half length for portability and low tunnel service. The instrument is packed in a light mahogany case, and this covered with a light sole-leather case, amply furnished with straps for "packing." With plain telescope, ...	$150.00
No. 2.	Same as above, but with level under telescope, vertical circle 4½ inches diameter, and clamps and tangent screw to axis of telescope, . .	180.00
No. 3.	Light Mountain Transit, same in all respects as the above, but with the addition of our patent solar attachment; vertical arc on silver. level on telescope with ground bubble and scale, and clamp and tangent to axis of telescope, complete, as shown in frontispiece, .	245.00

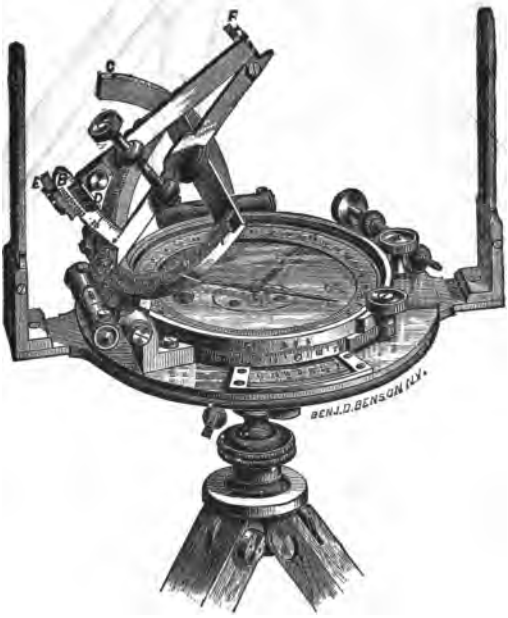


1002.

SOLAR TRANSIT.

No.		PRICE.
1001.	Burt's Solar Compass, with Adjusting Socket and Leveling Tripod,	$210.00
1002.	Solar Transit, with Tripod,	226.00
1003.	Patent Solar Attachment for Transits,	60.00
1004.	Vertical Arc divided on Silver, with Vernier reading to 30 seconds, with movable Tangent Screw,	18.00

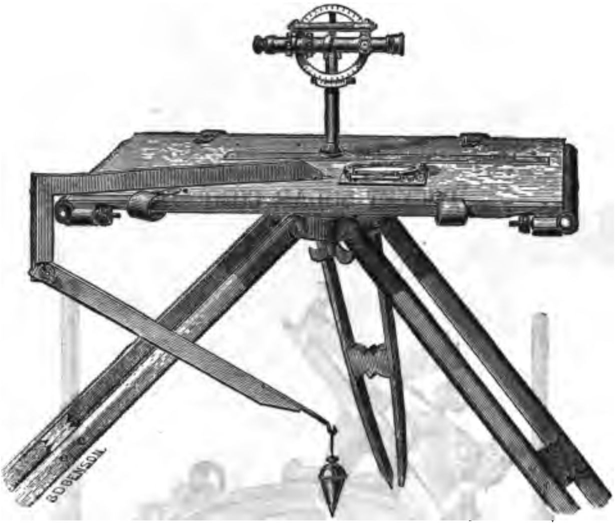
POCKET SOLAR COMPASS.



1004½.

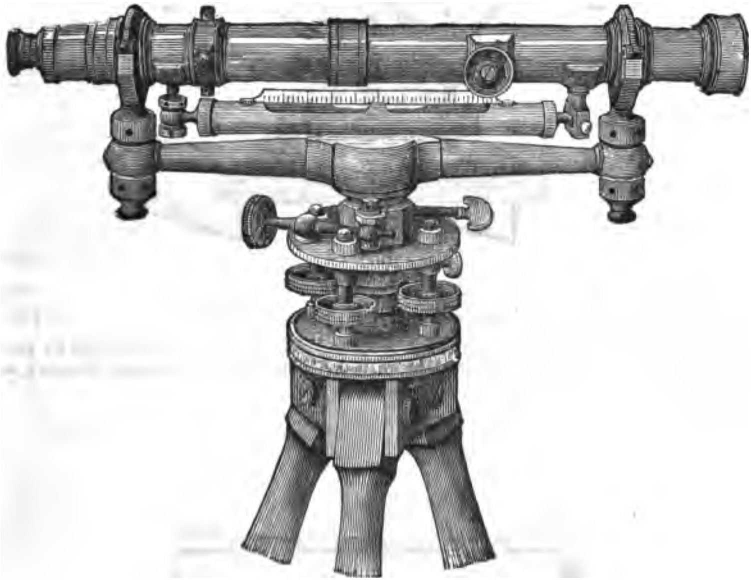
No.		Price.
1004½.	Pocket Solar Compass, complete with tripod and mahogany box, .	$105.00

PLANE TABLES.



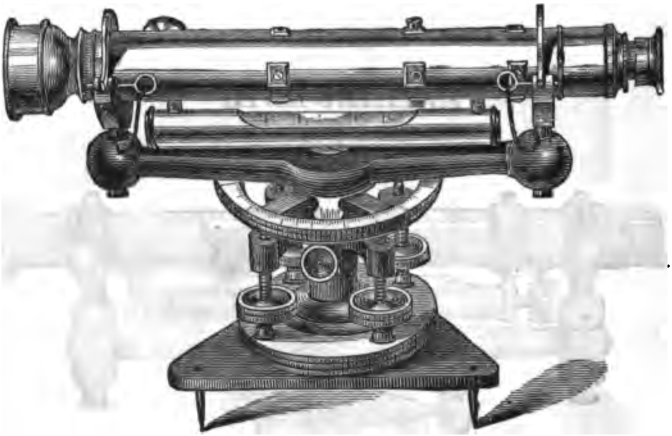
No.		PRICE.
1.	Plane Table, board 24x30 inches, mounted on large tripod, with leveling socket and clamp, and with plumbing-bar, plummet, and clasps for paper,	$45.00
	Combined compass and levels, with square base,	15.00
	Alidade with compass sights,	15.00
	Total,	$75.00
2.	Plane Table, with board, etc., same as No. 1,	$45.00
	Combined compass and levels,	15.00
	Alidade, same as No. 1, supplied with telescopic sight, with stadia, vertical circle to 5 minutes, level, and clamp and tangent,	50.00
	Total,	$110.00
3.	Plane Table, with board, etc., same as No. 1,	$45.00
	Combined compass and levels,	15.00
	Alidade with telescope 9 inches long, power 20 diameters, with stadia, vertical circle to 5 minutes, level on telescope, and clamp and tangent, mounted on column as in engraving,	70.00
	Total,	$130.00
4.	Plane Table, with board, etc., same as No. 1,	$45.00
	Combined Compass and levels,	15.00
	Alidade with telescope 11 inches long, with stadia, 4½-inch vertical circle on silver to 1 minute, level on telescope, and clamp and tangent, on column, power of telescope 24 diameters,	90.00
	Total,	$150.00
5.	Set of three leveling screws for any of the above-named Plane Tables, extra,	10.00
6.	Clamp and tangent, for movement in azimuth, extra,	5.00

ENGINEER'S LEVEL.



1005.

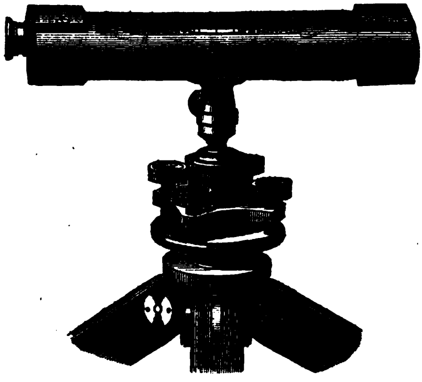
No.		Price.
1005.	Y Level of the most approved form and construction, with telescope either 16, 18, or 20 inches long. In this instrument the telescope is made to revolve readily and truly in the Ys by rings of bell-metal, which, when desired, may be firmly clamped by the clips, and held in any position. It has a rack-and-pinion movement to both object and eye-glasses, an adjustment for centering the eye-piece and another for insuring the accurate projection of the object-glass in a straight line. Both of these are completely concealed from observation and disturbance by a thin ring, which slides over them. The Ys of this level are made large and strong, of the best bell-metal, and each have two nuts, both being adjustable with the ordinary steel-pin. The level-bar is made round, of well-hammered brass, and shaped so as to possess the greatest strength in the parts most subject to sudden strains. The tripod-head has the same plates and leveling screws as that of the Engineer's Transit, ...	$110.00
1005½.	Same as 1005, but with telescope 22 inches long, ...	115.00



1009.

No.		Price.
1009.	The Architect's Level, including tripod, plumb-bob, box, etc., . .	$45.00

The instrument represented in the cut is intended to meet a want long felt by every intelligent architect, builder, millwright, and agriculturist—of a simple, compact, and servicable level, procurable at a very moderate cost.



1009¾.

1009¼.	Farmer's or Drainage	Level,	with	Jacob Staff mountings, . . .	15.00
1009½.	Do.	do.	do.	do. plain tripod, ...	20.00
1009¾.	Do.	do.	do.	do. tripod and leveling screws, . .	25.00

NEW QUICK LEVELING TRIPOD HEAD.

PATENTED BY

W. & L. E. GURLEY, TROY, N. Y.

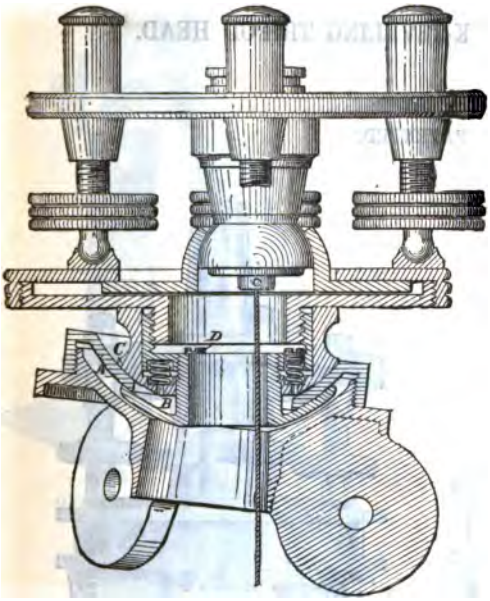


FIG. 1.

FIG. 1. Shows the quick leveling tripod head designed for level or transit, and without shifting plate.

The following engravings represent a new tripod head for Engineers' and Surveyors' instruments, greatly facilitating the leveling of an instrument, and making, as we believe, the most efficient quick leveling arrangement yet devised.

DIRECTIONS FOR USE.

Screw the instrument on the tripod as usual; if not nearly level, unscrew the leveling head a very little, a bare loosening of the screw is sufficient. The instrument will then be free to move upon the spherical surfaces A, B, C, in any direction required to bring the plates approximately level, and will be held in this position by the friction of the same surfaces.

Now screw the head fast again, firmly clamping the whole instrument to the tripod. The final ajustment of the level is then completed by the use of the leveling screws.

The friction of the spherical surfaces may be increased or diminished at will, by turning the screws "D," which compresses the spiral springs.

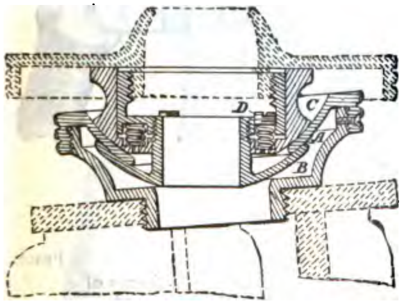


FIG. 2.

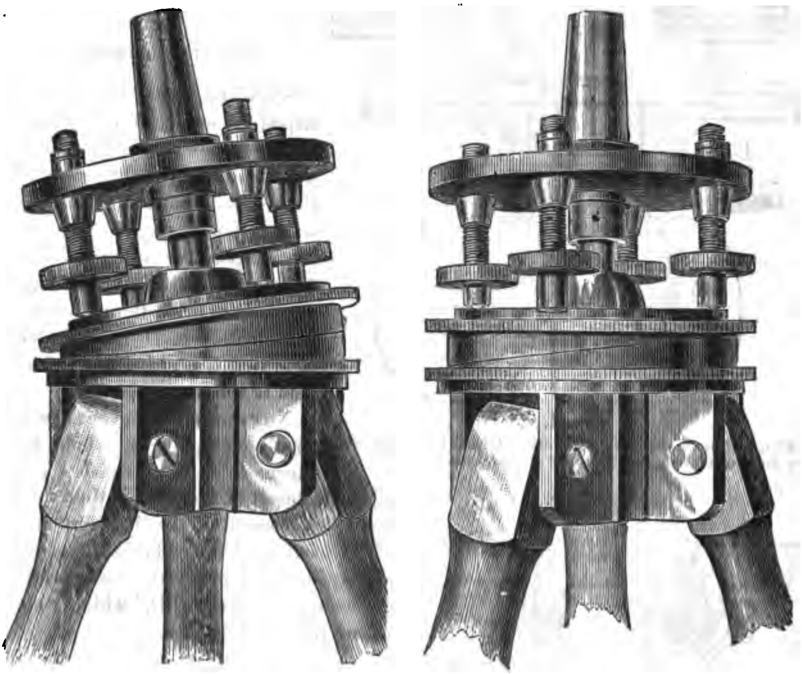
FIG. 2. Shows the quick leveling attachment as screwed fast to a tripod of any pattern now in use.

PRICES.—As shown in Fig. 1, when furnished with a new instrument, $5.00. For same, adapted to any instrument already in use, as in Fig. 2, $7.50.

N. B.—When No. 2 is ordered for any instrument, the lower plate of the leveling head, as shown in outline of same figure, or the brass head of the tripod, the legs being removed, may be sent to us by mail or express, prepaid, with a remittance of, say $9, to pay for attachment and return charges.

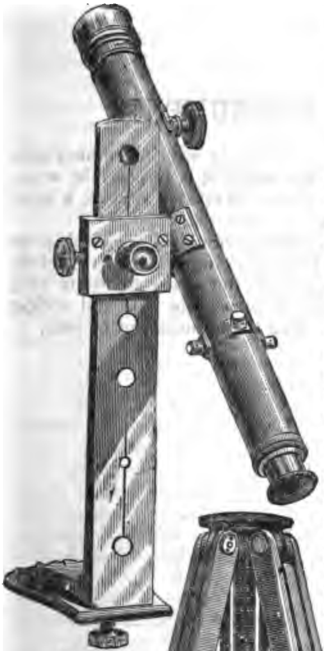
SÆGMULLER QUICK-LEVELING TRIPOD HEAD.

(PATENTED.)



PRICE.

The above cuts represents one of the simplest and most convenient forms of a quick-leveling head to be obtained. It consists of two wedge-shaped circular disks, which being revolved until their greatest diameters are on opposite sides, makes the instrument approximately level, the leveling being completed by the usual parallel plate screws, which clamp the instrument firmly when carrying, even if unclamped. It is impossible for any instrument to which this head has been attached to fall over. The head can be fitted to any make of transit or level, ... $10.00



977½.

977½. NEW TELESCOPIC SIGHT,

ATTACHABLE TO ANY COMPASS.

[PATENT APPLIED FOR.]

THE NEW TELESCOPIC SIGHT consists of a telescope furnished with the usual cross wires, etc., and attached to a movable band, which, as shown in the engraving, can be slipped over the sight of any compass, clamped at any point desired, and put in adjustment by a method so simple as to be within the reach of any person who has a screw-driver.

The surveyor can then use the telescope either in connection with the sights or entirely independent of them, running long lines, taking fore and back sights, and sighting up and down hills with perfect facility, and with an ease and accuracy surprising to one who has run lines only by the ordinary sights.

The New Telescopic Sight can be applied to any compass, and those ordering it need only to give us the width and thickness of the sight upon which it is to be placed to receive the apparatus, with full directions for its adjustment and use. It can also be detached when not in use, and replaced again without injuring its adjustments.

No. 1.—Nine-inch Achromatic Telescope, of low, but sufficient power, . . .	$12.00
No. 2.—Nine-inch Achromatic Telescope, larger diameter of object-glass and higher power, . . .	17.00
No. 3.—Same Telescope as No. 2, but furnished with micrometer or stadia wires for measuring distances, .	20.00

977¾.

977¾. PATENT EXTENSION TRIPOD,

To be used with any Instrument (in place of regular Tripod), extra, $5.00.

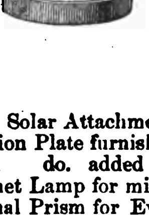
Price of Tripod complete , . . $15.00

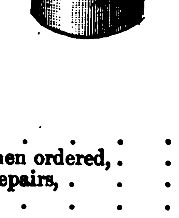
Our new Patent Extension Tripod has all of its legs so made that they can be shortened or lengthened at will. It is thus perfectly fitted for use in hilly country, and is specially adapted for use in mines where a short tripod is needed.

REPAIRS TO ENGINEERING INSTRUMENTS.

We are prepared to repair promptly, reliably, and cheaply any instrument sent us, no matter by whom they may be manufactured, and while it is impossible, without making a thorough examination, to give the exact cost of needed repairs, a brief statement may aid our customers in determining the relative cost.

When shipping, pack the instrument in its case, and this should be inclosed in an outside packing-box, the space being filled up with loose packing material. Inclose a note mentioning the repairs desired, each instrument being made to fit its own spindle, this part with the parallel plates, or if it is a compass, the ball and socket mountings must be forwarded with the instrument. The tripod need not be sent.





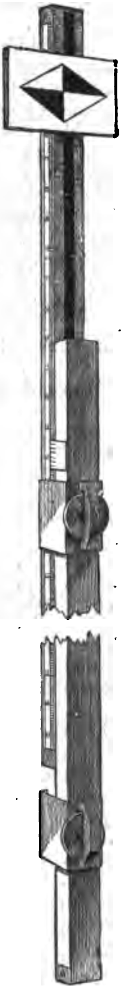
EXTRAS TO TRANSITS.

	Price.
Patent Solar Attachment, ...	$60.00
Variation Plate furnished with new Engineers' Transit when ordered, . .	4.00
Do. do. added to any Engineers' Transit sent for repairs, ...	15.00
Plummet Lamp for mining engineering, hung in gimbals, ...	12.00
Diagonal Prism for Eye-piece, ...	8.00
Reflector for Object-glass of Transit Telescope, ...	4.00

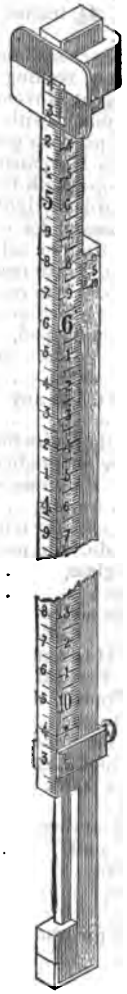
	PRICE.
Vertical Circle, 3½ inches diameter, divided on silver, vernier reading to five minutes,	$8.00
Vertical Circle, 4½ inches diameter, divided on silver, reading to single minutes,	12.00
Vertical Arc, 6 inches diameter, divided on silver, with vernier, movable by tangent screw, reading to thirty seconds,	18.00
Clamp and Tangent Movement to axis of telescope,	6.00
Gradienter, combined with clamp and tangent,	18.00
Level on telescope, with ground bubble and scale,	12.00
Rack and Pinion Movement to eye-piece,	5.00
Sights on telescope, with folding joints,	8.00
Sights on standards at right angles to telescope,	8.00
Detachable Telescope for vertical sighting, either Fig. 10 or 11,	25.00
Graduations of limb on solid silver,	10.00
Do. do. to read to 20″ or 30″,	10.00
Do. do. to read to 10″,	30.00
Do. on 4½-inch vertical circle, to read to 20″ or 30″,	5.00
Patent Extension Tripod,	15.00
Do. do. do. furnished instead of regular tripod, with any new instrument, extra,	5.00
Plain Tripod fitted to any Transit to order,	10.00
New Cross Wires,	3.00
Adjustable Stadia Hairs for telescope,	10.00
Plated Reflector for graduations,	4.00
Do. do. do. cross wires,	4.00
Needle and Centre-pin,	3.50
Ground-glass Level for telescope,	2.50
Do. do. do. plate,	.75
Cap for object-glass,	.75
Shade do.	.75
Variation Plate added to repaired Engineer's Transit,	15.00
Do. do. do. new do. do.	4.00
Regraduating Horizontal Limb and Vernier,	12.00
Do. Vertical do. do. do.	6.50
Repolishing Transit, either bright or bronze finish, $15.00 to	20.00
Compass Sights, each,	3.50
Clamp Screw, for spindle or sights, each,	1.00
Mahogany Tripod Legs, per set,	6.00
Target for New York and Philadelphia rod,	5.50
Clamp for rod,	2.50
Jacob Staff Mountings for compass, complete,	5.00
Steel Shoe for staff,	.75
New Centre Pin,	1.00
Compass Glass,	.50
Chamois Skin,	.50
Rubber Cover for transit or level,	1.00

1010.

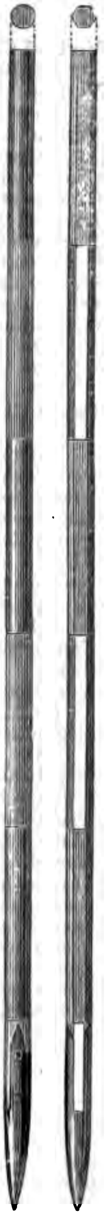
1011.



1012.



1012*a*.

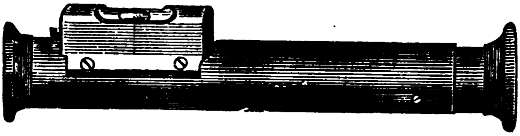


1013.

No.		Price.
1010.	Philadelphia Leveling Rod, made of seasoned mahogany,	$18.00
1011.	New York do. do. do. do. satin wood,	16.00
1012.	Boston do. do. do. seasoned mahogany,	16.00
1012*a*.	Architect's Rod, reading to inches and 16ths, . . .	6.00
1012*b*.	Metric Rod, ...	20.00
1012*c*.	Stadia Rod, ...	12.00
1012*d*.	English Rod, telescope pattern, ...	25.00
1013.	Ranging Poles, 6 feet long, with steel-pointed shoe, and divided off in feet, which are painted red and white, alternately, ...	2.50
1014.	Ranging Poles, 8 feet long, do. do. do.	2.75
1015.	Do. do. 10 do. do. do. do.	3.00

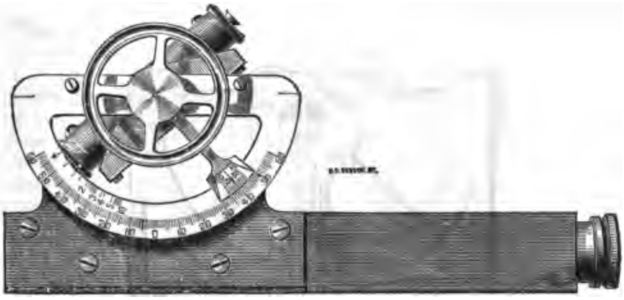
No.		Price.
1015½.	Steel Ranging Poles, 7 feet long, very accurate,	$6.25
1016.	Rod Level for Plumbing Rod or Pole,	5.00
1016½.	Plummet Lamps, for mining use, with Compensating Ring,	13.00
	Pair in box, with Strap,	28.00
1016¾.	Lamp for Mining Engineers, of copper, with Air Chamber, can be used on hat, in hand, or on table,	3.00

HAND LEVELS.



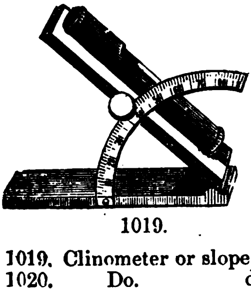
1017.

No.		Price.
1017.	Locke's Hand Level, made of German Silver,	12.00
1018.	Do. do. do. Brass,	10.00

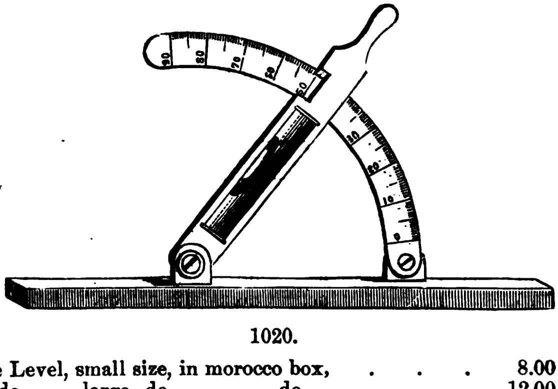


ABNEY LEVEL AND CLINOMETER.

No.		Price.
1018½.	Combines the "Locke Hand Level" with the Clinometer, giving angles of elevation and slopes, in wood box,	15.00
1018¾.	Reflecting Hand Mirror, for turning right angles,	7.50

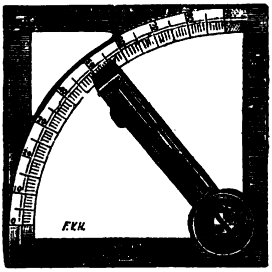


1019.



1020.

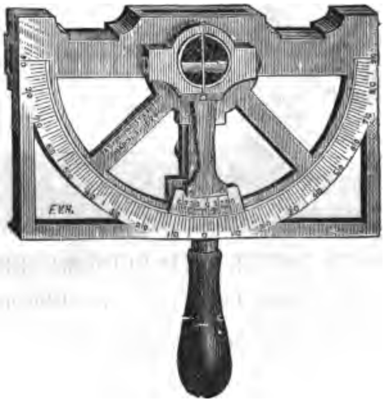
No.		Price.
1019.	Clinometer or slope Level, small size, in morocco box,	8.00
1020.	Do. do. large do. do.	12.00
1021.	Do. do. do. with perpendicular sights,	15.00



1021½.

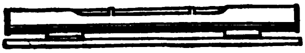
No.		Price.
1021½.	Clinometer of Square Frame, with arc running diagonally across, in box, ...	$12.00

This last form gives these instruments great firmness, and either of the four sides can be used for ascertaining the slope, thus enabling one to take the inclination of the under side of a plane.



1021¾.

1021¾.	Linton's Patent Combined Hand Level and Clinometer, . .	$20.00
1022.	Pocket Levels, mounted in brass, 3 inches long, ...	.70



1022.

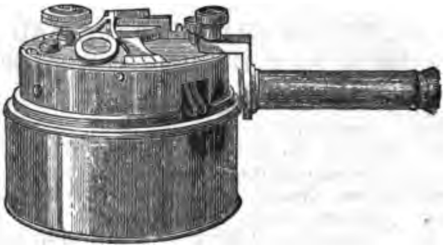
1023.	Pocket Levels, mounted in brass, 6 inches long, ...	1.50
1024.	Do. do. do. 9 do.	2.25
1025.	Do. do. do. 12 do.	3.00
1026.	Ground Level Bulbs, 2 to 6 inches long, each from . . .	.50 to 2.50
1027.	Unground do. do. do. do. . . .	.12 to .50
1027½.	Round Pocket Level, in case, mounted in brass, 2¾ inches in diameter,	2.00

Very delicate Ground Levels mounted to order.

CHAPTER XIII.

POCKET SEXTANTS, ODOMETERS, CHAINS, TAPE MEASURES, AND POCKET RULES.

1028.

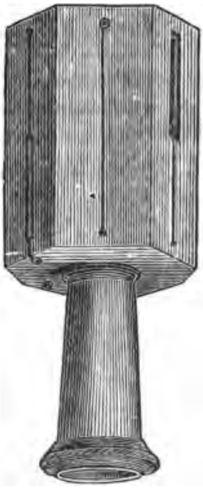


1030.

No.		PRICE.
1028.	Pedometer, an instrument for measuring distances walked, watch form and size, nickel-plated case, ...	$5.00
1029.	Pedometer, do. do. do. two dials, ...	7.50
1030.	Pocket Sextant with Telescope, very accurate, ...	50.00
1031.	Odometer, for measuring distances traveled by a carriage, ...	20.00
1031½.	Surveyor's Cross, for turning right angles, ...	3.00

SURVEYOR'S AND ENGINEER'S CHAINS.

1031.



1031½.

1032.

1032.	Surveyor's Chain, 2 poles, 50 links, No. 9, wire oval rings, . .	2.00
1033.	Do. 2 do. 40 do. 8, do. . .	2.75
1034.	Do. 2 do. 50 do. 8, do. . .	2.75
1035.	Do. 2 do. 50 do. 7, do. . .	3.75
1036.	Do. 4 do. 100 do. 9, wire round rings, . .	3.50

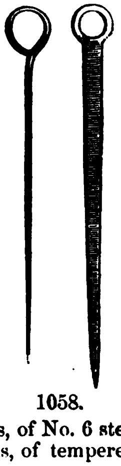
No.		Price.
1037.	Surveyor's Chain, 4 poles, 100 links, No. 8, wire oval rings,	$4.50
1038.	Do. 4 do. 100 do. 7, do.	5.50
1039.	Do. 4 do. 100 do. 12, best steel wire, brazed links and rings,	10.00
1040.	Do. 2 do. 50 do. 12, best steel wire, brazed links and rings,	5.50
1041.	Engineer's Chain, 50 feet, 50 do. 7, wire,	4.00
1042.	Do. 100 do. 100 do. 7, do.	6.00
1043.	Do. 50 do. 50 do. 12, best steel wire, brazed links and rings,	6.00
1044.	Do. 100 do. 100 do. 12, best steel wire, brazed links and rings,	11.50

GRUMMAN'S SPANISH VARA AND FRENCH METRE CHAINS.

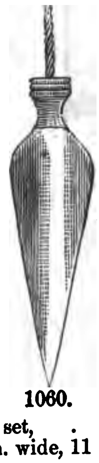
1045.	66 feet, No. 15 Tempered Steel Wire, 100 links, weight 1¼ lbs., with 10 extra links,	9.00
1046.	33 feet, No. 15 Tempered Steel Wire, 50 links, weight ¾ lbs., with 5 extra links,	5.00
1047	100 feet, No. 15 Tempered Steel Wire, 200 links, weight 2 lbs., with 15 extra links,	11.50
1043.	50 feet, No. 15 Tempered Steel Wire, 100 links, weight 1 lb., with 10 extra links,	6.00
1049.	33 feet, No. 12 Wire, 5 tallies, with 5 extra links, weight 1 10/16 lbs.,	5.50
1050	66 do. 12 do. 10 do. 10 do. do. 3 do.	10.00
1051.	50 do. 12 do. 5 do. 5 do. do 2⅛ do.	6.00
1052.	100 do. 12 do. 10 do. 10 do. do. 4⅛ do.	11.50
1053.	Spring Balance to use with either of the above-named chains,	2.00
1054.	50 feet, No. 18 Tempered Steel Wire, 100 links, no rings, with attachments of spring-balance, level, and thermometer, for very accurate measurements, weight ¾ lbs.,	15.00
1054⅛.	10 varas, 50 links, No. 8 Refined Iron Wire, each,	2.50
1054¼.	20 do. 100 do. No. 8 do. do.	4.00
1054½.	10 do. 50 do. brazed links and rings, No. 12 Steel Wire, tempered,	5.50
1054¾	20 varas, 50 links, brazed links and rings, No. 12 Steel Wire, tempered,	10.00

Metric Chains, 10 or 20 metres, same prices as those in varas.

1055.	Set of 10 Marking Pins, very light, with leather case,	2.00
1056.	Brass Plummet, to use with light chain,	2.00
1057.	Lead do. do.	1.50
1057½.	Marking Pins of No. 8 steel wire, 11 in a set, per set,	1.00
1057¾.	Do. do. 7 iron do. 11 do. do.	.75

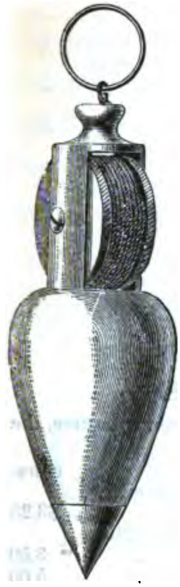


1058.

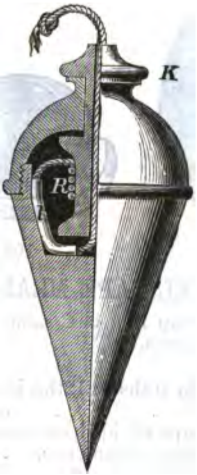


1060.

1058.	Marking Pins, of No. 6 steel wire, 11 in a set, per set,	2.00
1059.	Marking Pins, of tempered steel, 15 in. long, ¾ in. wide, 11 in a set, per set,	7.50
1060.	Plumbob, of brass, with steel point and screw top,	2.50
1061.	Same as No. 1060, but all steel,	2.50
1062.	Plumbob cord, per yard,	.06



1061½.



1063.

1067.

1061½.	Patent Adjustable Plumb-bobs (small), 8 oz., ...	$1.75
1061¾.	Do. do. (large), 13 oz., ...	2.25

Nos 1061½ and 1061¾ are constructed with a reel at the upper end, upon which the line may be kept, and by dropping the bob with a slight jerk, while the ring is held in the hand, any length of line may be reeled off. A spring, which has a bearing on the reel, will check and hold the bob firmly at any point on the line.

1063	has a concealed reel, around which the string is wound by turning the milled head on top. The friction upon the reel within will hold the bob at any desired point of the line, ...	2.50

TAPE MEASURES.

1065.	Best Linen Tape Measure, in strong leather case, 50 feet long, each, .	1.50
1066.	Do. do. do. do. do. 100 do. do. .	2.50

CHESTERMAN'S METALLIC TAPE MEASURES.

These tapes are made of linen thread interwoven with fine brass wire, not so liable to stretch as the usual linen tape, and better calculated to withstand the effect of moisture. They are in substantial leather cases.

1067.	Metallic Tape Measure, 24 feet long, in 10ths or 12ths, each, . .	1.80
1068.	Do. do. 33 do. do. do. do. . .	2.10
1069.	Do. do. 40 do. do. do. do. . .	2.35
1070.	Do. do. 50 do. do. do. do. . .	2.50
1070½.	Same as 1070, but in case with Flush Handle, ...	3.25
1071.	Metallic Tape Measure, 66 feet long, in 10ths or 12ths, each, . .	3.00
1072.	Do. do. 70 do. do. do. do. . .	3.25
1073.	Do. do. 75 do. do. do. do. . .	3.30
1074.	Do. do. 80 do. do. do. do. . .	4.00
1075.	Do. do. 100 do. do. do. do. . .	4.50
1075½.	Same as 1075, but in case with Flush Handle, ...	5.00
1075¾*a*.	Metallic Tape Measure, 50 feet long, divided in centimeters and meters on one side, and 10ths of a foot on the other, each, . .	3.75
1075¾*b*.	Same as 1075¾*a*, but 100 feet in length, each, ...	6.00

Chesterman's Metallic Tapes furnished without boxes at the following prices: 50 feet, each, $1.75; 66 feet, $2.25; 100 feet, $3.25.

1076.

1085.

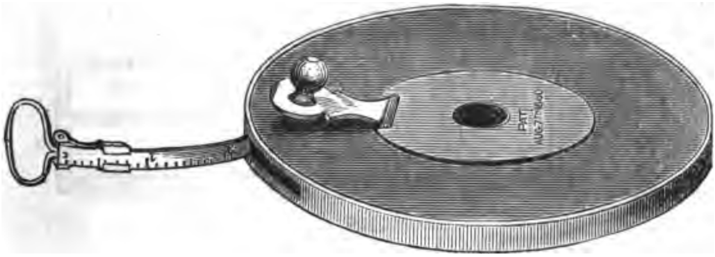
CHESTERMAN'S STEEL TAPE MEASURES.

Steel Tape Measures; all steel, to wind up in a box, same as linen measures, the most accurate, durable, and portable measures.

No.		Price.
1076.	Steel Tape Measure, 10 feet long, in 10ths or 12ths, in German silver case, each,	$3.25
1077.	Steel Tape Measure, 10 feet long, tape divided on one side to 12ths, and on the other to centimeters and millimeters,	3.50
1078.	Steel Tape Measure, 25 feet long, in 10ths or 12ths, each,	5.00
1079.	Do. do. 33 do. do. do. do.	5.75
1080.	Do. do. 40 do. do. do. do.	6.75
1081.	Do. do. 50 do. do. do. do.	7.00
1081½.	Same as 1081, but extra wide and heavy,	13.00
1032.	Steel Tape Measure, 66 feet long, in 10ths or 12ths, each,	9.00
1083.	Do. do. 75 do. do. do. do.	11.00
1034.	Do. do. 100 do. do. do. do.	14.00
1084½.	Steel Standard Measures, from 100 to 1000 feet, with graduations at every 50 feet:	
	Tape 100 feet, with Reel, Handle, and Stop,	10.50
	Each additional 100 feet,	5.50
	Large Brass Handles, to unship, each,	1.50
	Clamping Handle, each,	1.80
	Small Brass Clamp, to fasten on tape,	.75
	Every extra graduation and figuring, each,	.25
	The above tapes are made without joints and of precise U. S. standard; usually made about 300 feet in length, with graduations at every 10 feet, the last 10 feet with graduations at every foot, and the last foot into 10ths.	
1084¾*a*.	Steel Tape Measure, 50 feet long, divided into 10ths of a foot on one side, and millimeters and meters on the reverse side, each,	8.50
1084¾*b*.	Steel Tape Measure, 100 feet long, divided in 10ths and meters, each,	16.00
1084¾*c*.	Do. do. 20 meters long, divided in millimeters and meters, each,	9.00
1085.	Steel Tape Measure, 3 feet long, in German silver case, with spring and stop, tape divided into 10ths or 12ths of a foot,	1.50
1086.	Steel Tape Measure, 4 feet long, in German silver case, with spring and stop, tape divided into 10ths or 12ths of a foot,	2.00
1087.	Steel Tape Measure, 5 feet long, in German silver case, with spring and stop, tape divided into 10ths or 12ths of a foot,	2.25
1088.	Steel Tape Measure, 6 feet long, in German silver case, with spring and stop, tape divided into 10ths or 12ths of a foot,	2.50
1089.	Steel Tape Measure, 3 feet long, tape divided on one side to 12ths of a foot, and the other side to centimeters and millimeters,	1.75
1090.	Steel Tape Measure, 4 feet long, tape divided on one side to 12ths of a foot, and the other side to centimeters and millimeters,	2.25

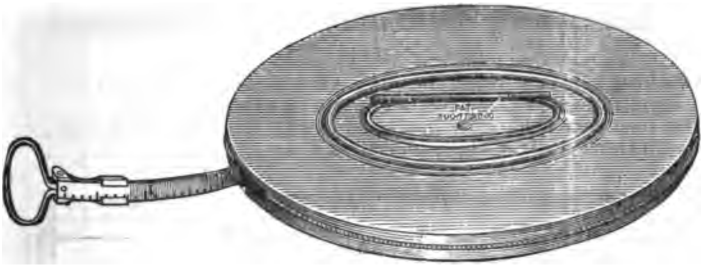
No.		Price.
1091.	Steel Tape Measure, 5 feet long, tape divided on one side to 12ths of a foot, and the other side to centimeters and millimeters, . .	$2.50
1092.	Steel Tape Measure, 6 feet long, tape divided on one side to 12ths of a foot, and the other side to centimeters and millimeters, . .	2.75
1093.	Linen Tape Measure, 3 feet long, in silver-plated cases, with spring and stop, ...	.50
1094.	Linen Tape Measure, 5 feet long, in silver-plated cases, with spring and stop, ...	.75
1095.	Linen Tape Measure, 6 feet long, in silver-plated cases, with spring and stop, ...	1.00

PAINE'S PATENT STANDARD STEEL TAPES.



1096.

1096.	Standard	Steel Tapes,	in japanned case,	25	feet long,	10ths	or 12ths,	3.50
	Do.	do.	do.	33	do.	do.	do.	4.50
	Do.	do.	do.	50	do.	do.	do.	6.00
	Do.	do.	do.	66	do.	do.	do.	8.00
	Do.	do.	do.	75	do.	do.	do.	10.00
	Do.	do.	do.	100	do.	do.	do.	12.00



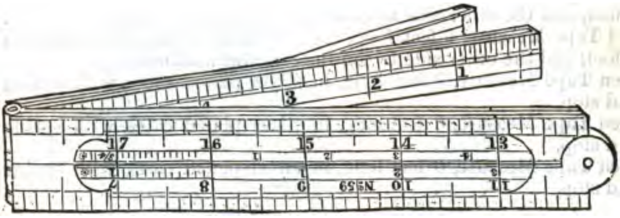
1097.

1097.	Steel	Tape Measure,	in leather case,	flush handles,	33	ft. long,	10ths	or 12ths,	5.50
	Do.	do.	do.	do.	50	do.	do.	do.	8.00
	Do.	do.	do.	do.	66	do.	do.	do.	10.00
	Do.	do.	do.	do.	75	do.	do.	do.	12.00
	Do.	do.	do.	do.	100	do.	do.	do.	15.00

EXTRAS TO PAINE'S PATENT STANDARD STEEL TAPES.

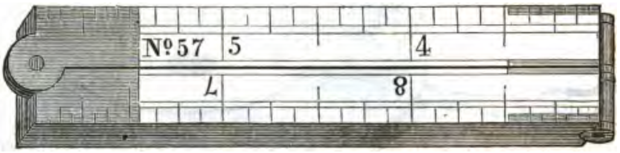
1098.	Handles, with graduated scale, per pair, ...	4.50
1099.	Pocket Thermometers, ...	1.50
1099½.	Spring Balance and Level, ...	5.00

POCKET RULES.



1100.

No.		Price.
1100.	One Foot, four Fold, boxwood, each, ...	$0.25
1101.	Do. do. do. brass edges, bound, ...	.75

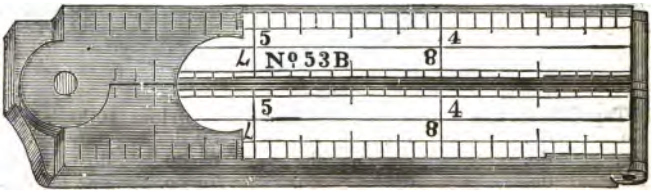


1102.

1102.	One Foot, four Fold, ivory, brass mounted, ...	1.00
1103.	Do. do. do. German silver mounted, ...	1.25

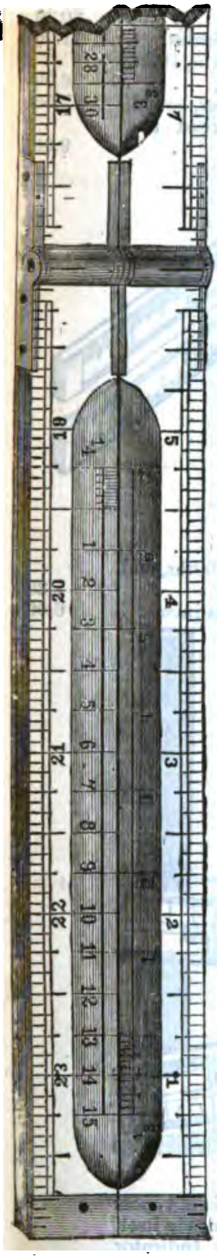
1105.

1104.	One Foot, four Fold, ivory, German silver mounted, graduated in 8ths, 10ths, 12ths, 16ths, and 100ths of a foot on edges of unbound, . .	2.25
1105.	One Foot, four Fold, ivory, graduated in 8ths, 10ths, 12ths, and 16ths, with German silver edges, bound, ...	3.00

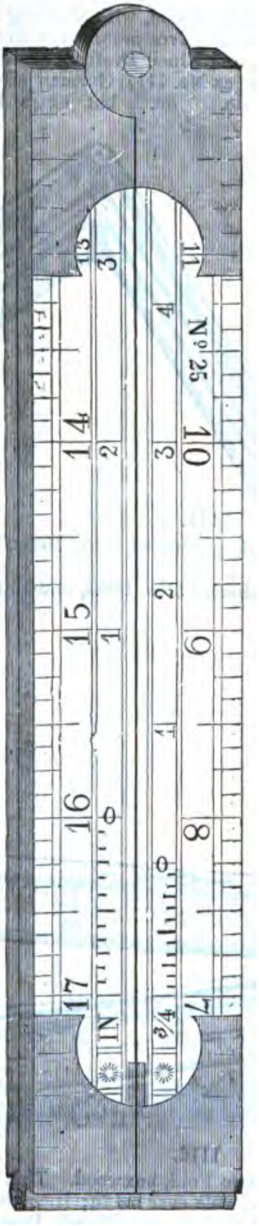


1106.

1106.	One Foot, four Fold, ivory, Caliper, graduated in 8ths, 10ths, 12ths, and 16ths, ...	3.00
1107.	One Foot, four Fold, ivory, Caliper, graduated in 8ths, 10ths, 12ths, and 16ths, with German silver edges, bound, ...	4.00
1108.	Two Feet, four Fold, boxwood, inside edges beveled with Drafting Scales, ...	1.00



1108.



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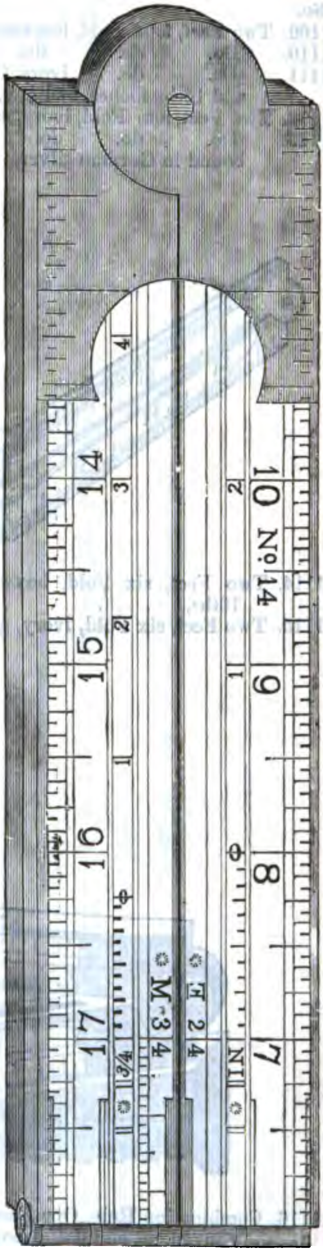
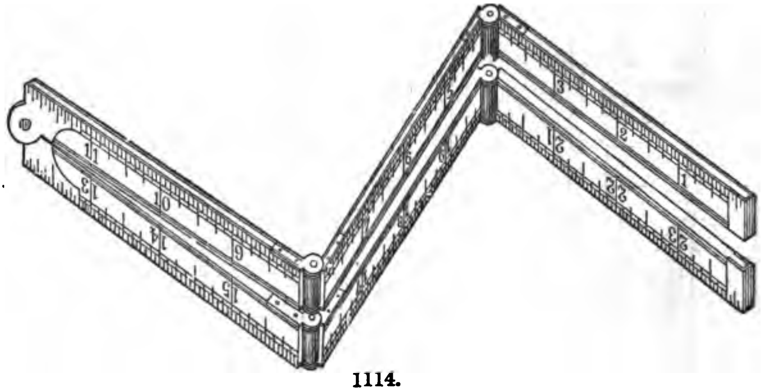


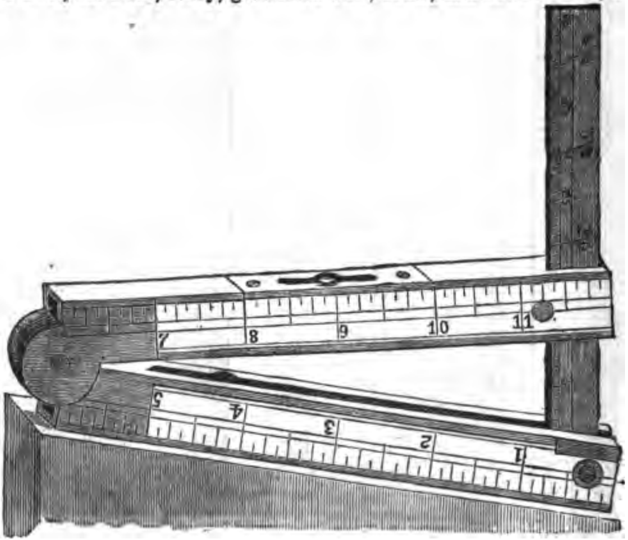
1112.

No.		Price.
1109.	Two Feet, four Fold, boxwood, ...	$0.30
1110.	Do. do. do. brass bound, with Drafting Scales, .	1.00
1111.	Do. do. ivory, German silver mounted, with 8ths, 10ths, and 16ths inches, and ¼, ⅛, ¾, and 1 inch Drafting Scales, . .	6.00
1112.	Two Feet, four Fold, ivory, same as No. 1111, German silver, bound,	7.50
1113.	Do. do. do. do. do. but extra broad and bound in German silver, ...	9.00



1114.

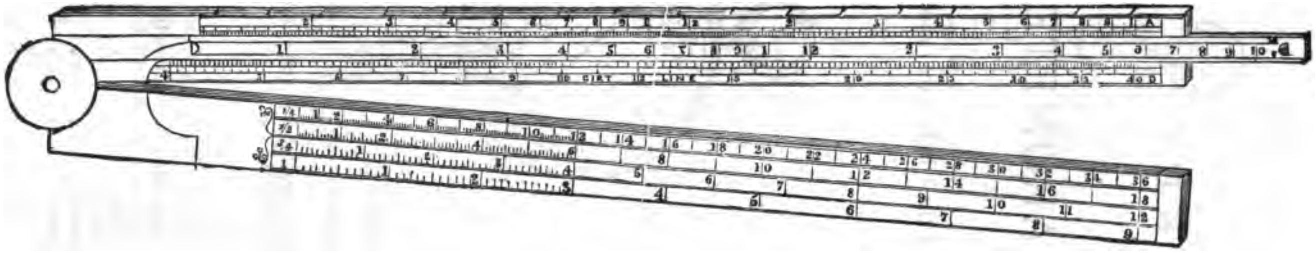
1114.	Two Feet, six Fold, boxwood, graduated 8ths, 10ths, 100ths, and 16ths, ...	1.25
1115.	Two Feet, six Fold, ivory, graduated 8ths, 10ths, and 16ths inches, .	6.00



1116.

1116.	Combination Rule, One Foot, two Fold, boxwood. This is the most convenient and useful pocket-rule ever made; it combines in itself a Carpenter's Rule, Spirit Level, Square Plumb, Bevel, Indicator Brace, Scale, Draughting Scale of equal parts, T Square, Protractor, Right-angle Triangle, and with a straight edge can be used as a Parallel Ruler, all the parts of which, in their separate applications, are perfectly reliable, ...	2.50

An explanation and directions for use accompanies each of the Combination Rules.



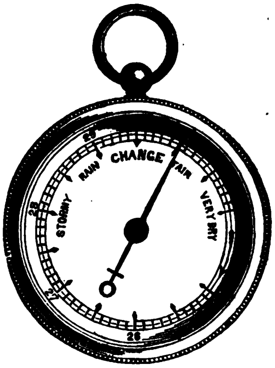
No.		Price.
1117.	Two Feet, two Folds, boxwood Slide Rule, Gunter's, ...	$1.25
1117½.	Treatise on the Gunter's Slide and Engineer's Rules, showing their utility, and containing full and complete instructions, enabling mechanics to make their own calculations. It is also particularly adapted to the use of persons having charge of cotton or woolen machinery, surveyors, and others. 200 pages, bound in cloth.	

Price, $1.00, net. *Sent by mail, post-paid, on receipt of price.*

POCKET

ANEROID BAROMETERS.

With Silver Enamelled Dials, in Morocco Cases.

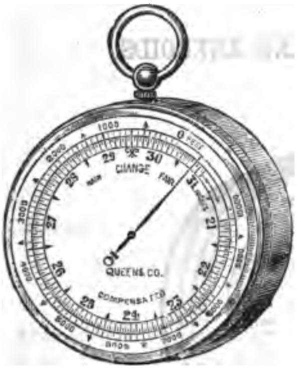


13500

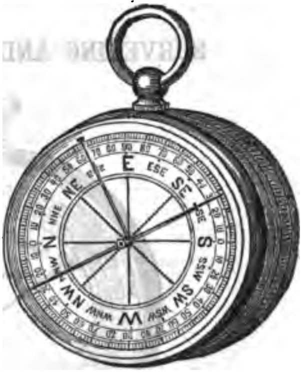
13505

13500.	Plain Pocket Aneroid, 1¾ in. diameter, ...	$15 00
13501.	Do. do. do. 2½ in.	17 00
13502.	Do. do. do. 1¾ in. diameter, with thermometer, .	20 00
13503.	Do. do. do. 3½ in. do. do. .	21 00
13505.	Pocket Mountain Aneroid, compensated for temperature, 1¾ in. diameter, with altitude scale to 3000 feet, ...	20 00
13506.	Do. do. do. 5000 feet, ...	20 00
13507.	Do. do. do. 10,000 "	21 00
13508.	Do. do. do. 15,000 "	24 00
13509.	Do. do. do. 20,000 "	27 00
13510.	Pocket Mountain Aneroid, compensated for temperature, same as 13505, 2½ inches diameter, with altitude scale to 3000 feet, .	20 00
13511.	Do. do. do. 5000 feet, ...	20 00
13512.	Do. do. do. 10,000 "	21 00
13513.	Do. do. do. 15,000 "	24 00
13514.	Do. do. do. 20,000 "	27 00

GEOLOGICAL ANEROIDS.

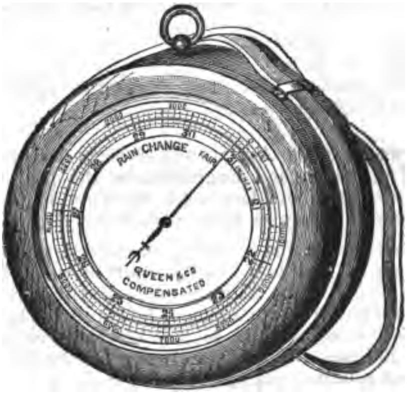


13515.
Front.



13515.
Back.

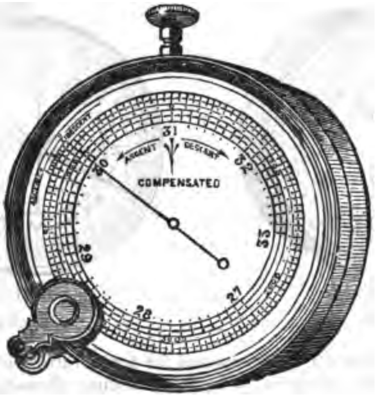
13515.	**Geological Aneroid**, compensated for temperature, silvered metal dial, with needle compass at back, 2½ inches diameter, in leather sling case, with altitude scale to 5000 feet,			$30 00
13516.	Do.	do.	10,000 feet,	31 00
13517.	Do.	do.	15,000 "	33 50



13520.

13520.	**Geological Aneroid**, compensated for temperature, with silvered metal dial, 5 in. diameter, in mahogany open face case, with leather strap, with altitude scale to 3,000 feet,			33 00
13521.	Do.	do.	5,000 "	33 00
13522.	Do.	do.	10,000 "	35 00
13523.	Do.	do.	15,000 "	37 00
13524.	Do.	do.	with thermometer, altitude scale to 3000 feet	35 00
13525.	Do.	do.	5,000 feet,	35 00
13526.	Do.	do.	10,000 "	37 00
13527.	Do.	do.	15,000 "	39 00

SURVEYING AND MINING ANEROIDS.



13530.

13530.	Surveying Aneroid, 5 in. diameter, compensated for temperature, silvered metal dial, graduated to hundredths, and reading by vernier to single feet, with magnifier, in leather sling case, with altitude scale to 5,000 feet,	$50 00
13531.	Do do 10,000 feet,	55 00
13532.	Do do 15,000 "	60 00
13534.	Mining Aneroid, same as 13530, but arranged to register 2,000 feet below sea level to 4,000 above	50 00

The Surveying and Mining Aneroid has been designed and constructed specially for the use of Surveyors and Engineers, for the purpose of readily ascertaining slight variations in gradients, levels, &c., and from its extreme sensitiveness will be found of considerable utility in Mining and Surveying work generally.

Besides extreme sensitiveness, the specialty claimed for this Instrument is an arrangement of the Scale of Altitudes which admits of subdivision by a Vernier, hitherto impracticable, owing to the Altitude Scale in ordinary use being a gradually diminishing one, to which a Vernier cannot be applied. In the present Instrument the action has been so adjusted as to give accurate readings upon a regular Scale of Altitudes, the Barometrical Scale of Inches having been made progressive so as to afford the correct relative readings with the Scale of Altitudes.

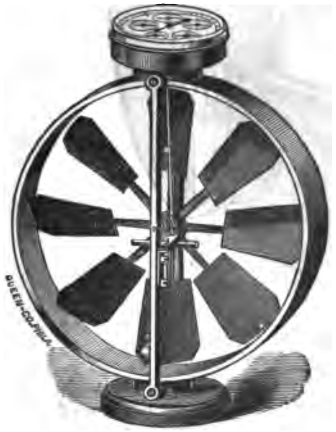
For Mining purposes the entire circle of the dial is graduated to represent 6 inches of the mercurial column, *i.e.*, from 27 inches to 33. This scale will register about 2000 feet *below* sea-level to 4000 feet *above;* the finest divisions, hundredths of the Altitude Scale, represent 10 feet measurements, which can be again subdivided by the Vernier Scale to *single feet.* The Vernier Scale is moved by a rack-work adjustment, and a magnifying lens which rotates on the outer circumference of the Instrument facilitates the reading of minute quantities.

For Surface Surveying purposes, where it is not required to be used *below* sea-level, the Instrument is made with the scale divided from 25 to 31 inches, thus giving an Altitude Scale of 5000 feet above sea-level only, and with this open scale and the assistance of the Vernier, the same minute readings can be easily taken.

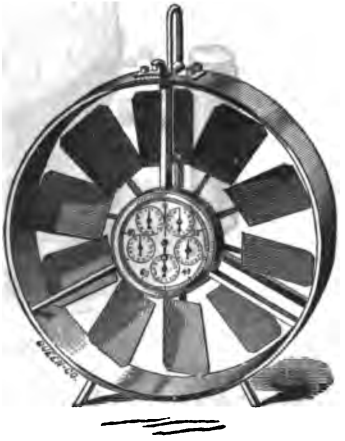
ANEMOMETERS.

FOR MEASURING THE VELOCITY OF CURRENTS OF AIR IN COAL MINES, AND VENTILATORS, FLUES, ETC., OF PUBLIC BUILDINGS.

The Anemometer, an instrument invented for the purpose of measuring the rate at which air moves in mines and ventilation passages, is now an indispensable adjunct of the former, the mining laws of most States requiring that a certain number of cubic feet of air shall be passed to the air-ways, and the Anemometer furnishing the most convenient and satisfactory mode by which the amount of air passing can be determined.

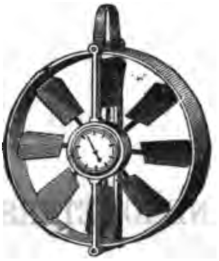

QUEEN-CO.PHILA.

No. 14,500.



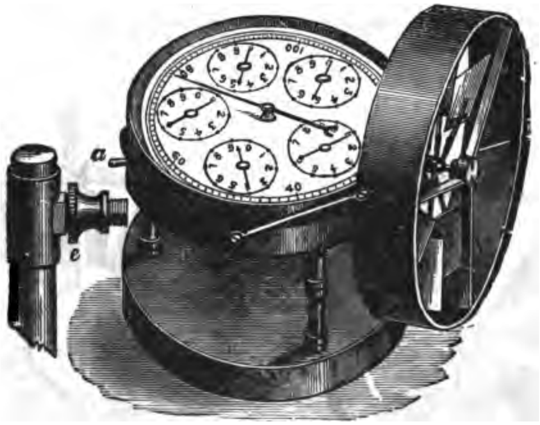
No. 14505.

14,500.	BIRAM'S ANEMOMETER, 6 inches diameter, reading to ten million feet, with disconnector, Fig. 1, ...	$40 00
14,501.	BIRAM'S ANEMOMETER, 5 inches diameter, same as 14,500, . .	39 00
14,502.	BIRAM'S ANEMOMETER, 4 inches diameter, same as 14,500, . .	37 50
14,505.	BIRAM'S ANEMOMETER, 12 inches diameter, reading to ten million feet, with disconnector, ...	45 00
14,506.	BIRAM'S ANEMOMETER, 6 inches diameter, same as 14,505, . .	40 00
14,507.	BIRAM'S ANEMOMETER, 4 inches diameter, same as 14,505, . .	37 50



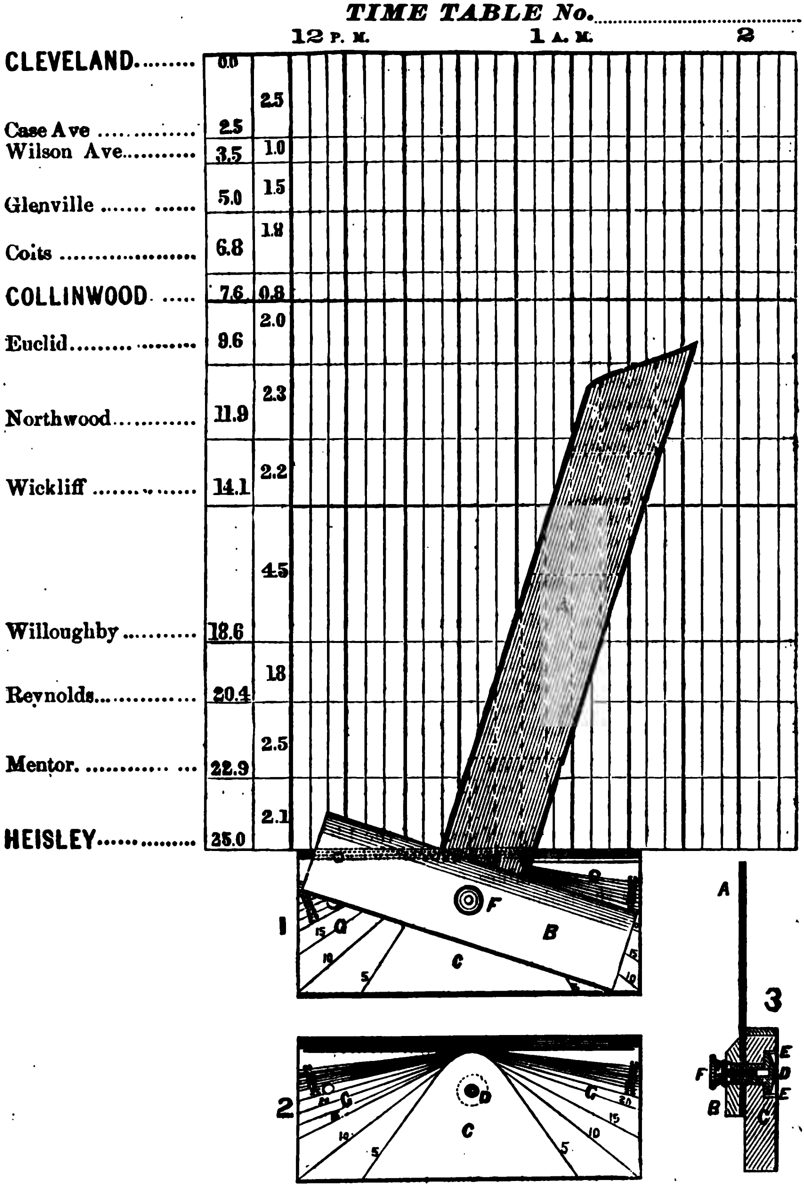
No. 14,508

14,508.	**Biram's Anemometer**, 6 inches diameter, reading to 1000 feet, with disconnector,	25 00
14,509.	**Biram's Anemometer**, 6 inches diameter, reading to 1000 feet, without disconnector,	22 50
14,510.	**Biram's Anemometer**, 4 inches diameter, reading to 100 feet,	20 00
14,511.	**Biram's Anemometer**, same as above, with disconnector,	22 50



No. 14.515.

14,515.	**The Portable Air Meter**, diameter of fan wheel 2¾ inches, with disconnector, which is extensively used for testing the ventilation of Hospitals, Schools and Public Buildings, forms also, an admirable Pocket Anemometer for tourists. The indications are obtained by the revolution of a series of fans (similar to those of Biram's Anemometer) acting first, upon a long hand capable of recording the velocity of fifty feet per minute on the large dial, divided to 100 feet, and then successively, by a train of wheels on the indices of five smaller dials, recording respectively, 100, 1,000, 10,000, 100,000 and 10,000,000 feet, or 1,893 miles,	30 00
14,516.	**Air Meter**, same as preceding, but reading only to 1,000 feet,	25 00
14,517.	**Watch Anemometer**, very small and sensitive, outside dimensions 2¾ in. in white metal hunting case,	40 00
14,518.	**Watch Anemometer**, same as above, in silver hunting case,	45 00



CLEVELAND	0.0	
		2.5
Case Ave	2.5	
Wilson Ave	3.5	1.0
		1.5
Glenville	5.0	
		1.8
Coits	6.8	
COLLINWOOD	7.6	0.8
		2.0
Euclid	9.6	
		2.3
Northwood	11.9	
		2.2
Wickliff	14.1	
		4.5
Willoughby	18.6	
		1.8
Reynolds	20.4	
		2.5
Mentor	22.9	
		2.1
HEISLEY	25.0	

1135.

The above cut represents, Fig. 1, the "Speed Protractor," as set at a speed angle of 25 miles per hour, and part of a Chart. Fig. 2 represents the lower head, C, with the speed scale, G, engraved on it. Fig. 3 is a cross section of the lower head, C, the upper and movable head, B, and part of the blade, A. The blade, A, is 42 inches long, made of hard rubber and backed with mahogany wood. The two heads, B and C, are made of steam-dried satin-wood and faced with ebony. Dimensions of lower head, C, 4x15 inches; of upper head, B, 2½x14½ inches. D, E, F, Fig. 3, represent the fixed brass pivot and thumbscrew, for setting the instrument at any required speed.

1135. Hill's Railroad Time Charts.

The principal features of the Charts are:

1. The positively *mathematical correctness* of the spacing.
2. The *ease* with which the five minutes, half hour, and hour lines can be distinguished, as well as their perfect *clearness* and *cleanness*.
3. Their *enormous size* (28x50), admitting of larger hour-spaces than any chart at present in use.
4. The *excellence* of the *paper* on which they are printed, as well as its *peculiar tint*, rendering it peculiarly fit for night work, while its cardboard-like texture obviates the necessity for dampening and stretching, and the consequent distortion of the diagram.
5. Their *cheapness*, which enables us to furnish them to railroads in smaller quantities and at a lower price than they could be obtained by lithographic or any other process.

The "*Speed Protractor*," which is generally used with the Charts, needs hardly any recommendation. The *simplicity* of its *construction*, the *care* bestowed in its *manufacture*, its greater *accuracy* than that of the semicircular angle protractor, and its *low price*, speak for themselves.

The price of the Charts, without name of stations, station lines, and heading, is $12.00 per quire; complete and ready for train plotting, the scale of prices is as follows, viz.:

50 Sheets,	$50.00
100 do.	80 00
150 do.	110.00
200 do.	140.00
Speed Protractor,	10.00

In favoring us with an order for complete Charts, please send list of *stations* with intermediate *distances*, and *underscore* such stations as you may desire to have printed in *heavy type* on account of their importance.

The following is an extract from a letter of Mr. James Tillinghast, General Superintendent of the New York Central and Hudson River Railroad, to whose judgment Mr. Hill submitted both Charts and Protractor:

"NEW YORK CENTRAL AND HUDSON RIVER RAILROAD,
Gen'l Supt. Office, Albany, N. Y., Jan. 15th, 1876.

ALBERT HILL, ESQ.:

"*Dear Sir:*—I am in receipt of yours of the 14th inst., with sample of diagram of Chart sheets. * * * I have not found any better plan to secure accuracy in forming the basis or proof of time tables. for the reason that it presents to the eye in a clear, condensed form, all the trains the schedule is to cover, and in such manner that the station figures are *accurately* indicated, and from which the figures for the printed form can be *readily copied*.

"Your plan of '*Speed Protractor*' is the *best* I have seen, and will be very useful in connection with the Charts, and I have no doubt that, with the facilities you mention for the production of charts *so accurately lined* as your process will produce, you will be able to secure orders. * * *

"Yours truly,

"JAMES TILLINGHAST."

The following is a list of some of the principal railroad companies by which these Charts have so far been adopted:

Pennsylvania Railroad.
Central Railroad of New Jersey.
Lake Shore and Michigan Southern Railroad.
Toledo, Wabash and Western Railway.
Cleveland, Tuscarawas and Wheeling Railroad, etc., etc.

If desired, we will send by mail, postage paid, a Chart of any of the above-named roads, as a sample.

POCKET MAGNIFYING GLASSES.

1138.

No.						Price.
1136.	Hard Rubber case and frame, round form,	1	double convex lens,	¾	in. diam.	$0.40
1137.	Do. do. do. do.	1	do.	1	do.	.60
1138.	Do. do. do. do.	1	do.	1½	do.	.75
1139.	Do. do. do. do.	1	do.	1¾	do.	1.25
1140.	Do. do. do. do.	2	do.	1	do.	1.00
1141.	Do. do. do. do.	2	do.	1¼	do.	1.50
1142.	Do. do. do. bellows form,	1	do.	¾	do.	.60
1143.	Do. do. do. do.	1	do.	1	do.	.75
1144.	Horn case, German silver frame, do.	1	do.	¾	do.	1.00
1145.	Hard Rubber case and frame, do.	2	do.	¾	do.	1.00
1146.	Do. do. do. do.	2	do.	1	do.	1.25
1147.	Horn case, German silver frame, do.	2	do.	¾	do.	1.50
1148.	Hard Rubber case and frame, do.	3	do.	¾	do.	1.50
1149.	Do. do. do. do.	3	do.		do.	1.75
1150.	Horn case, German silver frame, do.	3	do.	¾	do.	2.00

EXTRAS TO TRANSITS.

Vertical Circle, 3½-inch diameter, vernier reading to five minutes, . .	8.50
Do. 4½ do. do. single do. . .	14 50
Vertical Arc, 6-inch diameter, divided on silver, with vernier, movable by tangent screw, reading to 30 seconds, ...	20.00
Clamp and Tangent Movement to Axis of Telescope, ...	8.00
Level on Telescope, with ground bubble and scale, ...	15.00
Rack and Pinion Movement to Eye-glass, ...	5.00
Sights on Telescope, with folding joints, ...	9.00
Sights on Standards at right angles to Telescope, ...	9.00
Jointed Tripod Legs, for Mining Engineering, ...	6.50
Adjustable Stadia Hairs for Telescope, ...	10.00
Plated Reflector for Graduations, ...	4.00
Plated Reflector for Cross Wires, ...	4.00

EXTRAS TO COMPASSES.

Jacob Staff Mountings, brass head, ...	5.00
Jacob Staff Mountings, steel shoe, ...	.75
Needle and Cap, ...	3.50
Centre Pin, ...	1.00
Compass Glass, ...	1.00
Chamois Skin, ...	.50

CHAPTER XIV.

CATALOGUE OF SCIENTIFIC BOOKS.

ARCHITECTURE, CARPENTRY, AND BUILDING.

ABERDEEN. Grecian Architecture. By Earl of Aberdeen. (Weale's Series),	$0.40
ALLEN. Cottage Building. By C. B. Allen. (Weale's Series),	.60
ALLEN. Rural Architecture; being a Complete Description of Farm-houses, Cottages, and Out-buildings. By L. F. Allen. 12mo,	1.50
ARCHITECT'S (The) Guide; or, Office and Pocket Companion, for Architects, Engineers etc. By W. D. Haskell, G. Rennie, F. Rogers, and P. Thompson. 1 vol. 16mo, cloth,	3.00
ATWOOD'S Country and Suburban Residences,	1.50
———Modern American Homesteads. 46 plates,	3.50
AUSTIN. A Practical Treatise on Calcareous and Hydraulic Limes and Cements. By J. G. Austin. 1 vol. 12mo, cloth. London, 1862,	2.00
BARNARD. School Architecture. By Henry Barnard. 3d edition. 1 vol. 8vo, cloth. New York, 1849,	2.00
BAUMAN. The Art of Preparing Foundations for all kinds of Buildings. By Frederick Bauman,	.75
BELL. Carpentry Made Easy. By W. F. Bell. 1 vol. 8vo,	5.00
BICKNELL'S PUBLIC BUILDINGS,	3.50
——— Street, Store, and Bank Fronts,	4.00
——— School-house and Church Architecture,	3.00
——— Stables, Out-buildings, Fences, etc.,	2.50
——— Specimen Book of 100 Architectural Designs,	1.00
BICKNELL'S VILLAGE BUILDER. Elevations and Plans for Cottages, Villas, Suburban Residences, Farm-houses, Stables, and Carriage-houses, Stone Fronts, School-houses, Churches, Court-houses, and a Model Jail. 4to. New edition, with supplement,	10.00
——— Detail Cottage and Constructive Architecture,	10.00
———. By J. Blenkarn. 1 vol. 8vo. London, 1865,	9.00
BOWLER. Chapel and Church Architecture, with designs for Parsonages. By Rev. G. Bowler. Folio, illustrated,	7.50
BROOKS. Erection of Dwelling-houses, with Specifications, Quantities of Materials, etc. 27 plates. By S. H. Brooks. (Weale's Series),	1.00
——— New Designs for Chimney Pieces, with Elevations, Sections, Profiles, and Plans. By S. H. Brooks. 6 parts, royal 4to. London,	15.00
BULLOCK. The American Cottage Builder. By J. Bullock. 1 vol. 8vo, cloth. Philadelphia, 1869,	3.50
——— The Rudiments of Architecture and Building. By J. Bullock. 8vo, cloth,	3.50
BURN. Model Designs for Mansions, Villas, Cottage Residences, Park Entrances and Lodges, being Plans, Elevations, Sections, Detailed Drawings, and Descriptive Specifications. Arranged by Robert Scott Burn. 1 vol. 4to, half morocco,	15.00
BURNELL. Rudimentary Treatise on Limes, Cements, Mortars, Concretes, Mastics, Plastering, etc. By George R. Burnell. Fifth edition, with Appendices. (Weale's Series),	.60
BURY. Styles of Architecture. By T. Bury. (Weale's edition),	.80
BUTLER. Ventilation of Buildings. By W. F. Butler. With illustrations,	.50

CAMPIN. On the Construction of Iron Roofs, a Theoretical and Practical Treatise. By Francis Campin, C. E. With wood-cuts and plates of roofs lately executed. Small 4to, cloth. New York, 1868,	$2.00
CARPENTERS' and Builders' Guide,	1.00
CLEVELAND AND BACKUS. Cottage and Farm Architecture,	4.00
CROFF. Model Suburban Architecture, embodying Designs for Dwellings of Moderate Cost, together with elaborate and extensive Villas, etc., etc. By C. B. Croff, Architect. 1 vol. 4to. 1870,	5.00
CROFT'S Designs for Front Entrance Doors. 22 large plates,	5.00
CUMMINS AND MILLER. Designs for Street Fronts, Suburban Houses and Cottages. By M. F. Cummins and C. C. Miller, Architects. 1 vol. large 4to, cloth. Troy, 1868,	10.00
——— Modern American Architecture, containing designs and plans for Villas, Farm-houses, School-houses, Cottages, City Residences, Churches, etc. Also Trussed Roofs, Interior Stone Finish, and many exterior details. By M. F. Cummins and C. C. Miller, Architects. 1 vol. 4to, cloth. Troy, 1868,	10.00
CUPPER. The Universal Stair-builder, being a new Treatise on the Construction of Stair-cases and Hand-rail. By R. A. Cupper. 4to,	7.50
DEAN. A series of selected designs for Country Residences, Entrance Lodges, Farm Offices, Cottages, etc. By G. A. Dean. With numerous colored plates. 4to. London,	15.00
DE GRAFF. The Modern Geometrical Stair-builders' Guide. By S. De Graff, Architect. 4to, illustrated. Philadelphia, 1868,	5.00
DEMANET. Guide Pratique du Constructeur Maconnerie. By A. Demanet. 1 vol. 12mo, paper, and 1 vol. plates. Paris, 1864,	2.00
DENTON. The Farm Homesteads of England; a collection of plans of the most approved specimens of Farm Architecture. Edited by J. Bailey Denton, C. E. 2d edition. 4to, cloth. London, 1865,	25.00
DESIGNS (Original) for English Cottages, containing Views, Elevations, Plans, and all Detail Drawings, etc., etc. By a Practical Surveyor and Builder. 1 vol. 4to. London, 1866,	10.50
DICTIONARY of Terms used by Builders, Architects, etc. (Weale's Series),	2.50
DOBSON. Brick and Tile Making. By E. Dobson. New edition, revised by Robert Mallet. London, 1868. (Weale's Series),	1.20
——— Foundations and Concrete Works. By E. Dobson. (Weale's Series),	.60
——— The Art of Building. By E. Dobson. (Weale's Series),	.60
——— Masonry and Stone Cutting. By E. Dobson. (Weale's Series),	1.00
——— The Student's Guide to the Practice of Measuring and Valuing Artificers' Works. Edited by E. Dobson. 3d edition, with the additions on design by E. Lacy Garbett. 8vo, cloth, illustrated. London, 1858,	4.50
DOWNING. Cottage Residences. By A. J. Downing. 4to, cloth,	6.00
——— Hints to Persons about Building in the Country. By A. J. Downing. New York, 1868,	2.00
——— Architecture of Country Houses. By A. J. Downing. 8vo, cloth,	6.00
——— A Treatise on Landscape Gardening and Rural Architecture, by the late A. J. Downing, with Supplement by H. W. Sargent. 1 vol. thick 8vo, cloth. Finely illustrated,	6.50
EASSIE. Healthy Houses. A Hand-book of the History, Defects, and Remedies of Drainage, Ventilation, Warming, and Kindred Subjects. With 300 illustrations. By William Eassie, C. E. 12mo, cloth. New York, 1872,	1.00

ESTERBROOK AND MONCKTON. American Stair-builders. By W. P. Esterbrook and J. H. Monckton. Illustrated. 4to,	$8.00
FAIRBAIRN. The Application of Cast and Wrought Iron to Building Purposes. By William Fairbairn, C. E. 3d edition. New York, 1864. Illustrated. 1 vol. 8vo, cloth,	6.50
FRANCIS. On the Strength of Cast Iron Pillars. With Tables for the Use of Engineers, Architects, and Builders. By J. B. Francis, Civil Engineer. 1 vol. 8vo, cloth. New York, 1865,	2.00
GARBETT. Principles of Design. By E. L. Garbett. (Weale's Series),	.80
GARDNER. Common Sense in Church Building,	1.00
——— Homes and How to Make Them,	1.50
——— Illustrated Homes. 25 plans,	1.50
——— Home Interiors,	1.50
——— Interiors and Interior Details,	7.50
GOULD. Carpenter and Builders' Assistant. 27 plates,	2.50
——— American Stair Builders' Guide. 32 original plates,	3.00
HALLETT'S Builder's Specifications,	1.75
——— Builder's Contracts,	.10
HARNEY'S Barns, Out-buildings, and Fences. 120 designs. By G. E. Harney,	4.00
HATFIELD. The American House-carpenter. By R. G. Hatfield. 7th edition, 8vo, cloth. New York, 1869,	6.00
HOLLEY. Country Seats, containing Designs for Cottages, Villas, Mansions, etc. By H. H. Holley. 1 vol. 4to. New York, 1866,	5.00
——— Church Architecture. Illustrated with 35 lithographic plates. By H. H. Holley,	10.00
——— On Saw Filing,	.75
HOLLY. Carpenters' and Joiners' Hand-book. By W. Holly. 1 vol. 18mo, cloth. New York, 1868.	.75
HURST. A Hand-book of Formulæ, Tables, and Memoranda for Architectural Surveyors. By J. T. Hurst. 1 vol. 32mo, oblong. Phila. 1868,	2.00
HUSSEY'S National Cottage Architecture,	6.00
JACQUES. The House: A Manual of Rural Architecture, or How to Build Country Houses and Out-buildings. With numerous Original Plans. By D. H. Jacques. Revised edition. 1 vol, 12mo, cloth,	1.00
LAXTON. Bricklayers' Tables. By Henry Laxton, C. E. 1 vol. 4to. London, 1869,	2.50
LEEDS. Orders of Architecture. By W. H. Leeds. (Weale's Series),	.60
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CHAPTER XV.

THE USE OF MATHEMATICAL INSTRUMENTS.

In the foregoing Catalogue we have divided the sets of Drawing Instruments into three classes, viz.: Brass, Fine German Silver, and Extra Fine Swiss. The brass instruments are intended for schools; the fine German silver and the extra fine Swiss instruments for the practical draughtsman.

Without the aid of some drawing instrument, a student cannot obtain a thorough knowledge of Geometry, Trigonometry, or Surveying; but, as very few who go over these branches in youth ever make any practical use of them in after life, it is not necessary that the drawing instruments which are furnished to schools should be any finer in finish and quality than is sufficient for a clear demonstration of the problems. The sets of brass drawing instruments are equal to all the wants of a young student.

But to the practical draughtsman, his drawing instruments are next to his head and his hands, and they must be of the best material, well and accurately finished. He uses them every day and all day, and if they are not perfectly correct, the loss and delay occasioned by them in one instance will be much greater than the cost of a good set of instruments, which can be used his lifetime.

The fine German silver drawing instruments meet the wants of the practical man.

The extra fine Swiss drawing instruments are more nicely finished than the fine German silver; the metal of which they are made resembles more closely pure silver; they are more substantial in their construction, and consequently more durable. As a general rule, draughtsmen give the preference to the extra fine Swiss drawing instruments.

The fewest drawing instruments a mechanical or architectural draughtsman can possibly perform his work with are the following, viz.:

A pair of Plain Dividers, 5 or 6 inches long, as No. 66.
A pair of Dividers, 5 or 6 inches long, with changeable points, as No. 73.
A pair of Small Spacing Dividers, as No. 78.
A Spring Bow Pen, as No. 81.
A Spring Bow Pencil, as No 84.
A Drawing Pen, as No. 87.
A Drafting Scale.
A T Square.
A Triangle.
A Drawing Board.
An Irregular Curve.
Half dozen Fastening Tacks.

An engineer or surveyor can perform his work with fewer drawing instruments. The following list will suffice:

A pair of Plain Dividers. 5 or 6 inches long, as No. 66.
A pair of Dividers, 5 or 6 inches long, with changeable points, as No. 73.
A Drawing Pen and a Drafting Scale.

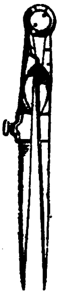
It must be borne in mind that the above are lists of instruments which are absolutely necessary for the architect and engineer to have, and without which he cannot follow his profession; but there are many other instruments mentioned in the Catalogue which can be added, and by their aid the work can be much simplified and more speedily accomplished.

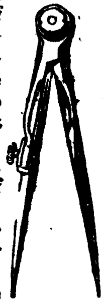
Having made these general remarks, we will now proceed to describe each of the drawing instruments, their use, and how to use them.

THE PLAIN DIVIDERS.

This instrument consists of two legs, the upper half of which are made of brass or German silver, and the lower half, or points, of tempered steel. In the fine instruments, the joints about which the legs move should be framed of the two different metals—German silver and steel; by this arrangement the wear is much diminished and greater uniformity and smoothness of motion is obtained. If this uniformity and smoothness be wanting, it is extremely difficult to set the legs quickly apart at a desired distance; for being opened and closed by the fingers of one hand, if the joint is not good they will move by fits and starts, and either go beyond or stop short of the point; but when they move evenly the pressure can be so applied as to open the legs at once to the exact distance, and the joint must be sufficiently tight to hold them in this position, and not permit them to deviate from it, in consequence of a small amount of pressure which is inseparable from their use. The joints of the dividers are tightened or loosened by inserting the two steel points of the key into the two small holes on one side of the head of the dividers, and turning from one to tighten it and in the opposite direction to loosen it.

THE HAIR-SPRING DIVIDERS.



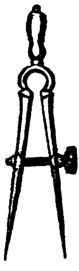


When greater accuracy in setting the legs apart is required than can be obtained by the joint alone, a draughtsman uses the Hair-spring Dividers. The peculiarity of these dividers is that the upper part of one of the steel points is formed into a bent spring, which, being fastened into the German silver portion of the leg, near the joint of the dividers, is made to fit into a groove cut the whole length of the German siver part of the leg, into which groove this spring can be drawn, or let slip out, by turning the screw on the middle of that side of the dividers.

No. 69 represents, the Hair-spring Dividers when shut up; No. 69*a* represents the same dividers with the spring let a little out of the groove by loosening the screw.

To take a distance with the Hair-spring Dividers they must be opened as nearly as possible to the required distance; set the leg without spring on the point from which the distance is to be taken, and make the point of the other leg coincide accurately with the end of the required distance, by loosening or tightening the screw on the side of the spring leg.

THE STEEL SPRING SPACING DIVIDERS.

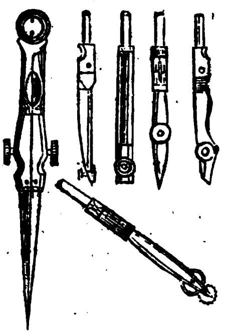


In mechanical and architectural drawings it frequently occurs that a large number of very small equal distances are to be set off, not only at one time, but repeatedly, upon the same drawing; for this purpose the ordinary dividers are too large and inconvenient to handle rapidly, and having nothing but the joint to hold them in their position, are liable to get their extension altered. For such work there is used a pair of very delicate dividers, made altogether of steel, the two legs of which are united at the top by an arched spring and drawn together or opened by the screw in the middle. On the top of the arched spring an ivory or German silver handle is attached, by which the instrument can be quickly turned over and over when used in spacing off a number of equal distances. The size of the spacing dividers mostly used are three inches long, with the legs delicately rounded from the regulating screw to the points. The advantages gained by these spacing dividers are greater nicety and accuracy of adjustment and no liability of accidental change when once adjusted.

DIVIDERS WITH CHANGEABLE POINTS.

If an arc or circle is to be described faintly, merely as a guide for the termination of other lines, the steel points are generally sufficient for the purpose; but when arcs and circles are to be drawn permanently and to show clearly, one point of the dividers must carry either a lead pencil or ink. To accomplish this the steel parts of the legs of the dividers are made so that they can be taken out and replaced by pieces, either for pencil or ink; the small screws in the middle of the legs retain the points firmly in their places. The cut 152 illustrates a set with a pen-point, *a*; a pencil-point, *b*; a dotting-point, *c*; a needle-point, *d*, and a lengthening-bar, *e*.

The pen-point, *a*, consists of two steel blades, so bent that when the points nearly touch each other there is space above for holding ink; the two blades are drawn together or put apart by a regulating screw in the middle. One of the steel blades works upon a joint at its upper end, so that the ink can be thoroughly cleaned off when the pen-point is to be put away, and thereby preventing its being injured by rusting.



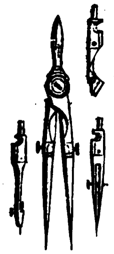
To use the pen-point, after securing it tightly in the proper side of the dividers, the ink is put in between the blades by a common writing pen, which should be drawn down and out between the points; then the points of the blades are brought to the proper distance apart for making the line—the closer the points are together the finer the line; the point of the pen must always be as near at right angles to the paper as possible; a joint is made in the German silver part of the point to regulate the proper inclination.

The pencil-point, *b*, is made of German silver, the lower part of which is formed into a tube; a lead-pencil is placed in this tube and held tightly by the clamp-screw on the side.

The dotting-point, *c*, is exactly like the pen-point, with the addition of a small toothed wheel, which revolves between the points of the blades, each tooth leaving a dot wherever it touches the paper; and thus, instead of a continuous ink line, a line of dots is made; such lines are meant to illustrate the course of an imaginary line or arc.

The needle-point, *d*, is made similar to the pencil-point; the tube on the lower end is only large enough to take a fine needle, which is held securely in its place by the thumb-screw on the side. The needle-point is put in place of one of the steel legs of the dividers when a number of arcs are to be made from the same centre; it does not deface the drawing by large holes, as the ordinary steel points would. The pen, pencil, dotting and needle-points are all made with a joint near their upper end, in order to bring the points at right angles with the paper.

The lengthening-bar, *e*, is made wholly of German silver, one end of which fits in place of one of the steel legs of the dividers and the other end has a socket and binding-screw for receiving and holding the pen, pencil, or dotting-point. It is used when larger circles or arcs are to be drawn than can be made by simply extending the legs of the dividers. The side of the dividers into which the needle-point fits, also the steel point and the needle-point, are marked on the inside with small dots to indicate where these points are to be put when used; those points which are marked thus are to be used on the other side of the dividers.

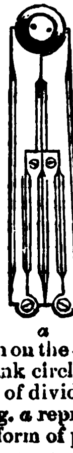


In a large drawing there is always a good amount of finer detail, which can be executed with more accuracy and ease by a set of small instruments. The cut, No. 72, illustrates a set one-half the size of No. 73, but constructed and used in the same manner. It is not provided with the dotting-pen and lengthening-bar. Above the joints of the dividers a handle is attached, by which it can be held and used with more facility than by taking them by the joints, as is done with the large set.

No. 158 represents a set of instruments similar to No. 72, but has a spring over the joints and a regulating screw in the middle of the legs by which the points can be opened or drawn together with great nicety and exactness. The handle is of ivory and much longer than that of No. 72. With No. 158 there are two pen-points; when they are both substituted in place of the steel points, an instrument for drawing parallel lines is obtained; or, in other words, a railroad drawing-pen, the use of which see cut No. 92, page 10.

POCKET DIVIDERS.

It is oftentimes found convenient by the engineer and surveyor to have a pair of dividers for use in the field which can be carried with safety in the pocket; these are called pocket dividers; the simplest form is a pair of ordinary plain dividers, 5 or 6 inches long, having a German silver sheath, with a blunt point, which screws over the steel points. No. 74 represents this form.

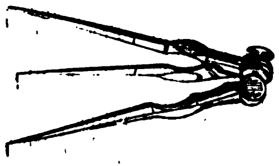


a

Another form of the pocket dividers is so constructed as to include points for pen and pencil, and yet all contained in a very small compass. No. 79 represents this form. The legs of these dividers are joined together same as the ordinary plain dividers, but each of them is again jointed about the middle, so that the ends can be folded in toward the upper joint; a deep slot is made in each leg; from their ends, and running almost up to the middle joints in these slots, the steel points are neatly adjusted on pivots; the opposite end of one steel point is finished into a drawing-pen, and the opposite end of the other into a tube for holding the lead-pencil; thus, when the steel points are revolved, either a pencil or pen-point is presented. When not in use, the legs are folded in at the middle joint; the inner sides of the legs of the dividers are filed out to receive the points, so that when they are not in use every delicate part is protected from injury. It will be readily seen, that with the legs of the dividers fully extended, and both of the sharp steel points presented to the paper, that we have an ordinary pair of dividers; by revolving the point which has the drawing-pen on the opposite end we will then have a pair of dividers with pen-point for describing ink circles; but if we should revolve the other steel point, we should then have a pair of dividers with pencil-point for describing arcs and circles with the lead pencil. Fig. a represents No. 79 drawn on a larger scale and folded for the pocket.

Another form of pocket dividers is represented by No. 179. The legs are jointed together the same as an ordinary pair of dividers, but instead of being solid they are drilled out from the end almost up to the joint. The steel points, instead of having the pen and pencil-points at their opposite ends, as in No. 79, are jointed in the middle. When not in use the pen and pencil-points are slipped into the holes in the legs of the dividers and the steel point bent up against the inside, as represented in the cut. When a pair of plain dividers is wanted, the steel points are turned out straight with the legs of the dividers. When a pair of dividers with pen-point is wanted, the pen is withdrawn from the dividers and the steel point slipped into the hole in the leg; and in the same way the pencil-point takes the place of its steel point, when a lead-pencil circle is to be drawn. For making very small circles, either of ink or lead-pencil, the points can be withdrawn from the legs of the dividers and used independent of them, as the steel point, with pen-point, of itself is a bow pen, and the steel point, with lead-pencil holder, is a bow pencil.

THREE-LEGGED DIVIDERS,



or, triangular compasses, are used for transferring triangular areas from one drawing to another. It is an ordinary pair of plain dividers, with a third leg attached by a universal joint to the face of their joint, so that whatever may happen to be the form of the triangle the legs can be turned to bring each of the points upon one of the angles.

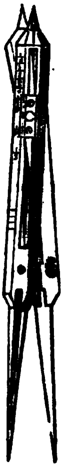
To use the triangular dividers, open the main legs to take in the base; then open and turn the third leg and bring it upon the angle above the base; the legs of the dividers are now set to the form of the triangle, which can be transferred correctly to any other drawing.

BISECTING DIVIDERS,

or wholes and halves, is a pair of ordinary dividers, with the legs continued beyond the joint, the legs above the joint being made exactly one-half the length of those below, therefore, when the longer legs are extended to any two points the distance between the points of the shorter legs will be one-half of that between the longer points. This instrument is very useful when a drawing is to be reduced one-half or enlarged double the size of a given copy. If one of the points should get broken it will be necessary to alter all the other points, and keep up the proportion between the short and long legs.

PROPORTIONAL DIVIDERS.

This instrument is designed for dividing a line into any number of equal parts; for describing regular polygons in given circles; for reducing or enlarging the area of a drawing, and also for taking the square and cube root of numbers.



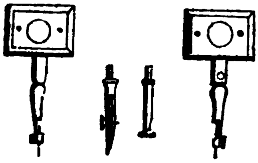
The bodies of the legs of these dividers are made of a flat piece of German silver, or brass, with a rectangular opening cut in each nearly the whole length; the ends of the legs are armed with steel points; the longest two are four or five times the length of the shortest ones. The legs are put together with the rectangular openings exactly opposite each other, and retained in their place by clamp plates and a thumb-screw, which can be moved up and down the opening and made tight at any desired point; these clamp plates and thumb-screw constitute the joint of the dividers, upon which the legs are opened, and it is easy to perceive that if this joint is exactly half way between the extremity of the points the two ends will open to the same distance, but if the joint is moved nearer one end the opening of the points will bear the same proportion to each other as the longer does to the shorter part.

The cheaper form of these dividers (No. 23, p. 4) have but one set of graduations, by which lines only can be subdivided; the proportions are $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, $\frac{1}{7}$, $\frac{1}{8}$, $\frac{1}{9}$, $\frac{1}{10}$; that is, if the line across one of the clamp plates is made to come opposite either of the divisions on the leg, the two ends of the dividers will open in that proportion.

The best proportional dividers (Nos. 76 and 159, pp. 9 and 23) have one side of one of the legs graduated for dividing lines into $\frac{11}{12}$, $\frac{5}{6}$, $\frac{3}{4}$, $\frac{2}{3}$, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, $\frac{1}{7}$, $\frac{1}{8}$, $\frac{1}{9}$, $\frac{1}{10}$, $\frac{1}{11}$, and the other side of the leg is graduated for inscribing regular polygons of 6, 7, 8, 9. 10, 11, 12, 13, 14, 15, 16, 17, 18, 19 and 20 sides in given circles. To use the lines of polygons, bring the line across the clamp plate to coincide with the graduation which is marked with the number that the polygons is to have sides, then open the dividers and make the long steel points take in the radius of the circle, then the distance between the small points will be the length of one side of the required polygon. As very few proportional dividers are made with the graduations for enlarging the area of a drawing, and those for taking the cube and square root of numbers, on account of their practical use being very limited and quite complicated, we have concluded to omit their description, and refer those who wish to be informed upon the use of those graduations to Heather's Treatise on Mathematical Instruments, page 5.

The joint of most of the proportional dividers is slipped along the rectangular opening by the hand; but it is frequently quite difficult to bring it exactly to the right place, as a little too much pressure will move the line a little too far, and an opposite pressure may put it too far in the original direction again. For nicety in adjusting the joint to the required point, some proportional dividers are fitted with a bar and micrometer screw, by which the joint can be drawn exactly to the required division. (See No. 162, p. 23.) Another plan is to have a rack fitted on the inside of the rectangular opening and a pinion attached to the sliding joint fitting into it; by turning the milled thumb-screw of the pinion the joint is moved up and down in the rectangular opening with great regularity and exactness. Great care must be taken that none of the points of the proportional dividers get broken, for if one is broken all four must be altered, so that the graduations shall still represent the right proportions.

BEAM COMPASSES.



In drawing a circle of very long radius, for which the dividers with lengthening bar are insufficient, the draughtsman is obliged to make use of the beam compass, of which there are two forms. No. 80 represents one form, without the beam, which is made of wood. The main parts consist of two rectangular clamps, of German silver or brass, to the under side of which the points are attached. One of the points is made so that it can be detached and in its place a point either for ink or lead pencil substituted. To use this form of beam compasses, fasten the metal clamps to the edge of a wooden ruler at the distance apart of the radius of the circle to be described; with one point upon the required centre, the other point is swung around, and the arc or circle completed. Under the whole length of one of the clamps a screw with fine thread and milled head is attached; upon this screw the point is adjusted; by turning the milled head, the point can be made to traverse from one side of the clamp to the other. The object of this screw is, after having adjusted the clamp on the ruler as near as possible, to enable the draughtsman to bring the points very accurately to the required distance apart by turning it one way or the other.

No. 170 represents the other form of the beam compass, in which the bar or rod is of German silver, about one-fourth of an inch in diameter, and divided into two or more sections, with screw joints, for the purpose of convenience in packing away when not in use. The points are attached to German silver tubes, which slide along the rod. One of the tubes can be adjusted to any position on the rod; but the other is fixed at one end, and can only be moved by the adjusting screw to regulate small distances. To prevent the tubes carrying the points from turning on the bar, a groove is cut the whole length of the bar, in which run steel guides projecting from the inside of the tube. When the bars are screwed together, care must be taken to have the groove in each section brought to its right position to make the cut continuous. With these beam compasses there are two round steel points, a needle, pen, and pencil points; the needle point fits in place of the round steel point, which is attached to the stationary tube, and the pen and pencil points fit in place of the steel point attached to the movable tube.

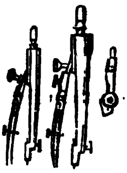
THE BOW PEN AND BOW PENCIL.

These instruments are indispensable to an architectural or mechanical draughtsman for describing small circles from one-sixteenth of an inch to two inches in diameter, such as the heads of screws, the hubs and tires of wheels, etc., etc.

There are two kinds of bow pens and bow pencils. Those represented by adjacent cuts are about three inches long, and the legs are extended and closed by the pressure of the fingers; the joint, upon which the legs move is the same as in the ordinary plain dividers; one of the legs is made with a permanent needle point, the other leg is a pen or pencil point; both legs are jointed in the middle, so that the points can always be set at right angles to the paper.

The other and best form of bow pen and bow pencil is that with spring and adjusting screw. Of these there are two kinds. Those represented at Nos. 81 and 84 are made wholly of steel, except the handle, which is either of ivory or German silver. The legs are made of one straight piece of steel, which is bent in the middle until the two points come within one inch of each other, and then highly tempered. A steel wire, three-fourths of an inch long, having a fine thread cut on it, is fastened to the middle of one leg, and passes through the other; a small German silver nut is screwed on the end of this wire, and pressing against the leg, forces the points closer together; the parts of the legs above the screw being of tempered steel, when the nut is loosened the points will move back with it.

The other form of the spring bow pen and bow pencil is represented by Nos. 82 and 83. The leg, body, and handle are made of one piece of German silver or brass, three inches long; the lower end of the leg is finished with a small tube and clamp screw for receiving and retaining a needle point; the body is almost twice the width of the leg, and a groove is cut the whole length of one of its sides; the pen or pencil point is attached to a tempered steel spring, the end of which is screwed fast into the upper end of the cut in the body; a steel wire, half an inch long, with a fine thread cut on it, is fastened into the body, and passes through the spring just above the pen or pencil point; a nut is screwed on the end of this wire, and bears against the spring and forces it in or lets it out of the cut in the body, which brings the pen or pencil and the needle point nearer together or puts them farther apart. No. 82 represents the bow pen; the bow pencil is constructed in the same manner, but has a point for lead pencil instead of ink. No. 83 has both a pen point and a pencil point, and by simply changing one point for the other, can be used as a bow pen or bow pencil.



DRAWING PENS.

This is a most important instrument to every draughtsman, and should be well made and always kept in good order. It consists of two steel blades, attached to an ivory handle, and so bent that when the points are almost touching there is space between the blades for holding ink. One of the blades is hinged where it joins the handle, so that it can be opened away from the other blade when it is to be cleaned. A steel screw, having a German silver head, is passed through the hinged blade and screws into the other blade; by turning this screw the points can be brought to the distance apart for making the required thickness of line. There are three sizes of these pens, viz.: 4½ inches, 5½ inches, and 6½ inches long from the point of the pen to end of handle. To use the drawing pen, put the ink between the blades with a common writing pen, drawing it down and out between the points of the blades; screw the blades to the proper distance apart for making a line the required thickness. In drawing the line the pen should be held firmly against the ruler, slightly inclined in the direction the line is being drawn; the points of both blades must touch the paper. The handles of most drawing pens are made to unscrew, and a needle is fitted in the screw end, which can be used for pricking drawings from one paper to another.

When lines of red ink are to be drawn it is found best to use a drawing pen having the blades made entirely of German silver instead of steel, as the acid in the ink does not act upon and injure the German silver as quickly as it does the steel.

RAILROAD DRAWING PEN.

For drawing close parallel lines in mechanical and architectural drawings, or to represent canals and railroads, a double drawing pen is used. It consists of two drawing pens attached parallel to each other on one handle; the distance of the two pens apart is regulated by the adjusting screw between the end of the handle and the top of the pens.

DOTTING PEN.

The dotting pen is made like the drawing pen; but has a finely toothed wheel, which revolves between the points, and instead of a continuous ink line it makes a dot for each tooth, and consequently a line of dots, when drawn between two points. It is used when imaginary lines are to be shown on the drawing.

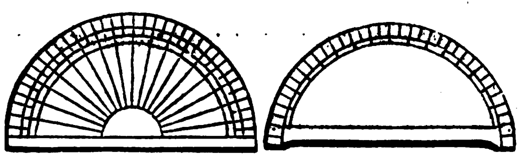
MAP PERAMBULATOR.

The map perambulator is used for measuring the length of curved lines, such as the courses of rivers and roads, etc., etc. It consists of a finely toothed wheel, about three-fourths of an inch in diameter, working back and forward upon a fine steel screw; the screw is supported in a neat German silver frame, to which an ivory handle is attached. To use the instrument, screw the wheel against the side of the German silver frame, from which a point projects almost to the lower edge of the wheel, then roll the wheel along the crooked line until it reaches the end; then go to the scale on the edge of the map or drawing and roll the wheel back to the side of the frame from which it was started, and the length of the crooked line will be ascertained.

Every draughtsman should provide himself with a fine oil stone for dressing the points of his dividers and pens, so as to keep them always in perfect working order; he should also have a fine piece of buckskin, for wiping the instruments off before returning them to the case. In handling and using the instruments the steel parts should come in contact with the fingers as little as possible, as the perspiration rusts the steel, but does not materially injure the brass or German silver.

THE PROTRACTOR

is used for plotting surveys and laying off angles in general. Nos. 301 and 306 represent semicircular pieces of horn, brass, or German silver, on the middle of the diameter of which a dot or small cut is made, indicating the centre; the edges are divided into 180 parts or degrees, or 360 parts or half degrees. The best protractors are always divided in half degrees. The horn protractors are made of a solid piece of horn, rolled as thin as writing paper; they are transparent, and the lines for each ten degrees are drawn almost from the centre to the edge (see No. 301). To reduce the weight of metal protractors, and render them more convenient to use, a semicircular piece is cut out, leaving all round an edge one-half to three-quarters of an inch across; the circular edge is then divided in degrees or half degrees (see No. 306).



To protract a survey, draw a north and south line, and take a point about the middle; bring the centre of the protractor over this point, and make the straight edge come even with the line; now set off the bearings on one side of the line for eastings, and on the other for westings; then remove the protractor, and draw faint lines from the centre to the points marked off, and with the parallel ruler, dividers, and scale, bring the lines to connect and form a figure of the survey. To set off an angle from a given point on a given line, bring the centre of the protractor to the point, and make the edge come on the line; then with the point of the dividers mark on the paper where the required degree comes, and draw a line from the given point to that point, and the angle made by the two lines will contain the required number of degrees.

There is always more or less difficulty in marking off the degrees from the protractor, with the point of the dividers, to do it accurately and distinctly, so that when the protractor is removed the direction of the required line can be readily seen. To obviate this difficulty the protractor with arm is made; the arm is simply a ruler of the same material as the protractor, jointed to the centre, so that it can be revolved from one side to the other; it projects about three inches beyond the edge of the protractor After sitting the protractor on the line with its centre over the point from which the line is to start, bring the beveled edge of the arm to the required degree, and with the point of the pencil resting against that edge, draw a straight line; now, when the protractor is removed, there is no doubt about the position and direction of the line.

The protractor with arm is divided in half degrees, and with it angles can be laid off correctly to fifteen minutes, but when great accuracy is to be observed, and the angles are required to be laid off to the very minute, a vernier must be attached to the arm. It is made by widening the arm and cutting a square opening in it at the part where it crosses the edge of the protractor; the edge of the opening which meets the graduated edge of the protractor is divided in such a manner as to enable the parts of a degree less than thirty minutes to be accounted for correctly when laying off the angle. For a general description of verniers, see Gillespie's Land Survey, Chapter II, page 228.

A whole circle protractor is made and used the same as the half circle, it is, in reality, two half circle protractors, having the same diameter.

The bevel protractor is made of steel; it is half circle and with arm; its straight edge projects beyond the arc both ways. The arm, instead of being fastened permanently at the centre, as is the case in other protracters with arms, has a narrow opening cut in it, almost from one end to the other; the arrangements which hold the arm to the protractor fit in this cut and a clamp nut retains it in its place; by loosening the clamp nut the arm can be slipped so as to project above the arc, or below the straight edge, as may be wanted. This protractor is intended for the use of machinists in obtaining or laying off bevels upon a piece of machinery.

RECTANGULAR PROTRACTOR.

This form of protractor is generally made of ivory, and six inches long, by one and three-quarters to two and a half inches wide; three edges of one side are divided in parts corresponding to the degrees and half degrees of the semicircular protractor; the other edge has a division half way between the ends which represents the centre of the circle and the point in which the lines around the three edges would all meet if continued.

To understand the graduations around the edges, take a half circle protractor and bring its centre to the mark on the side not graduated, and make its straight edge correspond with that side; now, it will be found that where the graduations on the edges of the two protractors come in contact they represent exactly the same number of degrees; and if the other lines on the rectangular protractor were continued they would meet the corresponding ones on the semicircular protractor. This protractor is used for the same purposes and in the same manner as the semicircular protractor.

Besides the protracting scale around the edges, one side of the rectangular protractor has on it a diagonal scale of equal parts, and scales of 20, 25, 30, 35, 40, 45, 50, and 60 equal parts to the inch; also, a scale of chords for arcs of a circle four inches diameter; on the other side are scales of $\frac{1}{8}$ in., $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, 1, $1\frac{1}{2}$, $1\frac{1}{4}$ in., each subdivided into twelve parts; also, a scale of chords for arcs of a circle six inches diameter; the edge which has the centre mark on it is divided into forty parts to the inch.

The diagonal scale consists of a series of eleven parallel and equi-distant straight lines; across these, and at right angles to them, another series of lines are drawn, having the spaces between every two lines to measure exactly one-quarter of an inch. The top and bottom line of the eleven parallel lines have the first quarter of an inch divided into ten equal parts, also, the last half of an inch. A line is drawn from the first of these small subdivisions of the first parallel line diagonally across the other nine lines, to the beginning of the subdivided part of the lower line; and from each of the other subdivisions of the upper line, lines are drawn parallel to the first diagonal line. It is readily seen that at the point where one of these diagonal lines crosses each one of the nine parallel lines, it increases its distance from the perpendicular line by one-tenth of one of the small subdivisions for every parallel line.

To take off distances of two figures, say 46—chains, feet, or miles—place one point of the dividers at the fourth perpendicular line on the top parallel line, and open the dividers to the sixth subdivision at the beginning of the line. If we have three places of figures to take off, say 467—chains, feet, or miles—open the dividers as before, along the top line, from the fourth perpendicular line to the sixth subdivision; now bring the point of the dividers down the fourth perpendicular line to the seventh parallel line; the other point of the dividers then will not be on the intersection of the sixth diagonal line and the seventh parallel line; but when it is opened to that point the dividers will take in the required distance, viz., 467.

General Rule.—To take off any number to three places of figures from a diagonal scale: on the parallel line, indicated by the third figure, measure from the diagonal line, indicated by the second figure, to the perpendicular line, indicated by the first figure.

ENGINEERS' CHAIN SCALES, OF EQUAL PARTS,

are those which have one inch, or a portion of an inch, divided into a number of equal parts; they are marked 20, 25, 30, 35, 40, etc., etc.; and it is to be understood that each one of the fine divisions at the beginning of the lines is that part of an inch represented by the figures before the line; that is, if 20, each one is the $\frac{1}{20}$ of an inch, and if 40, each division is the $\frac{1}{40}$ of an inch. There are but ten of the finer divisions marked off at the beginning of each line; after that, each graduation represents ten of the very small ones. On the ivory protractors, and the scales usually with sets of instruments, it will be found that there is another set of divisions over the fine ones on each line; these divide the first large space into twelve equal parts.

The measuring chains used by engineers are fifty or one hundred feet long, and each link one foot long; therefore, if each one of the large divisions on the scales is called a chain, the fine divisions will each represent ten links, if the chain used be one hundred feet long, and five links, if a fifty foot chain is used. The size of the drawing is therefore regulated by the selection of one of these scales to lay off the length of the lines by. If the measures are in feet and tenths of a foot, each of the large divisions can be called one foot, and each of the fine divisions will be one-tenth of a foot. If the measure is in feet and inches, each one of the large divisions can be called one foot, and each one of the twelve fine divisions above the other fine divisions will be one inch.

ARCHITECTS' SCALES, OF EQUAL PARTS.

In making a plan of a building or a drawing of a piece of machinery, it is necessary to make a small fraction of a foot represent a line, which, in reality, measures a whole foot; the scales mostly used for this purpose are $\frac{1}{16}$ of an inch $\frac{3}{32}$, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, 1, $1\frac{1}{2}$, and 3 inches to the foot; that is, every 16th of an inch is laid off the whole length of the scale, to represent feet, and the first 16th is divided into twelve equal parts, to represent the inches; and the same with the $\frac{3}{32}$, and all the other divisions to 3 inches to the foot.

SCALE OF CHORDS.

The chord of an arc is a straight line joining the two extremities of the arc. The graduations on the scale of chords represents the length of the chords of all arcs, from one degree to ninety degrees. The chord of an arc of sixty degrees is always equal to the radius or half the diameter of the circle. The chord of sixty is always used for describing arcs for laying off angles or measuring angles already laid off.

On some of the ivory scales there are found a number of other graduations, marked Rhu., Lon., Sin., Tan., S. T., Lat. These initials stand for Rhumbs, Longitudes, Sines, Tangents, Semi-tangents, and Latitudes. As these are only used in the study and application of navigation we will omit describing them here, and refer those who wish to know their application to Heather's Treatise on Mathematical Instruments, page 16.

The scales described in the preceding pages are those usually found on the six-inch ivory protractors and six-inch ivory scales. As a general rule, draughtsmen would prefer scales of greater length than six inches, and with only a certain class of divisions on them. The Ivory Chain Scale is twelve inches long, and has two edges beveled and graduated either to 10 and 10 parts to the inch, or 10 and 20, and so on up to 100 parts to the inch, the fine graduations being continued the whole length of scale.

The Triangular Chain Scale is made of well-seasoned boxwood; the six edges are graduated each with a single scale, viz.: one edge has 10 parts to the inch, one 20 parts, one 30 parts, one 40 parts, one 50 parts, and one 60 parts.

The Triangular Scale for architects has five edges, graduated with two scales on each edge, as follows: one edge has each $\frac{3}{32}$ of an inch, and each $\frac{3}{16}$ of an inch marked off; the $\frac{3}{32}$ are numbered from one end and the $\frac{3}{16}$ from the other. One edge has each $\frac{1}{8}$ of an inch, and each $\frac{1}{4}$ of an inch; one edge has each $\frac{3}{8}$ of an inch, and each $\frac{3}{4}$ of an inch; one edge has each $\frac{1}{2}$ of an inch, and each an inch; one edge has every $1\frac{1}{2}$ inches, and every 3 inches; and one edge is divided into inches and 16ths of an inch. The first division of the $\frac{3}{32}$ scale is divided into four equal parts; consequently, if the $\frac{3}{32}$ represent one foot, each of the subdivisions will represent 3 inches. The $\frac{3}{16}$, $\frac{1}{8}$, $\frac{1}{4}$, and $\frac{3}{8}$ have the first division divided into twelve equal parts; therefore, if the primary divisions represent one foot, each of the subdivisions will represent one inch. The $\frac{1}{2}$ and $\frac{3}{4}$ of an inch have the first division divided into twenty-four equal parts; therefore, if the primary divisions represent one foot, each of the subdivisions will represent the half of an inch. The 1 inch and $1\frac{1}{2}$ inches have the first division divided into forty-eight equal parts; and if the primary division represent one foot, each of the subdivisions will stand for one-quarter of an inch. The 3 inches has the first division divided into ninety-six equal parts; and if the primary division represent one foot, each of the subdivisions will represent the one-eighth of an inch.

The Ivory and Boxwood Flat Architect's Scales, Nos. 406 and 454, are 12 inches long by $1\frac{1}{8}$ inches wide, and have the following divisions on them, viz.: $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, $1\frac{1}{4}$, $1\frac{1}{2}$, $1\frac{3}{4}$, 2, $2\frac{1}{4}$, $2\frac{1}{2}$, $2\frac{3}{4}$, and 3 inches to the foot; the $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, and 1 inch divisions are graduated on the two edges of one side—all the other divisions are laid off on the body of the scale. The primary division of each scale is divided into twelve equal parts, to represent inches, and in the $\frac{3}{8}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, $1\frac{1}{4}$, $1\frac{1}{2}$, $1\frac{3}{4}$, 2, $2\frac{1}{4}$, $2\frac{1}{2}$, $2\frac{3}{4}$, and 3-inch scales, the primary divisions of each are also divided into ten equal parts, by faint dots over the twelve parts; each one of these represent the one-tenth of a foot, when the primary division is taken for one foot.

The Ivory and Boxwood Architect's Scales, with 16 different graduations, all brought to the edge. Nos. 410 and 458 have the same graduations on them as Nos. 406 and 454, but have them arranged in such a manner that the divisions of each graduation come out to one or the other of the four edges. The advantage of having the graduation on scales come out to the edges is, that the edge of the scale can be brought to the line, and the required distance marked off without taking it with the dividers, thereby insuring greater accuracy and less trouble.

PAPER SCALES.

A very convenient though not very lasting scales; are printed from copper-plates on strips of card-board; they are 19 inches long by 1½ inches wide; each strip has but one scale on it, and that on one edge. They are usually put up in sets of six, thus: ¼, ½, ¾, 1, 1½, and 3 inches to the foot, for series A; and 5/32, 1/8, 3/16, 5/16, 3/8, and 7/8 of an inch to the foot, for series B; and 10, 20, 30, 40, 50, and 60 parts to the inch, for series C. These scales being made of the same material as the paper upon which the drawing is made, the expansion and contraction, from moisture and heat, are equal upon both; another advantage is, they are not as liable to soil the paper as scales made of other material.

STEEL RULES, OR SCALES.

These scales are intended for the use of machinists in making nice measurements on delicate work. They are made of steel, and divided into inches on all four of the edges; the first inch on one edge is divided into 16 equal parts, the next inch into 32 equal parts, and the next into 64 equal parts. Another edge has the first inch divided into 20 equal parts, the next inch into 50 equal parts, and the next inch into 100 equal parts. Another inch has the first inch divided into 12 equal parts, the next inch into 24 equal parts, and the next inch into 48 equal parts; and the fourth edge has the first inch divided into 8 equal parts, the next inch into 14 equal parts, and the next inch into 28 equal parts.

THE SECTOR.

These are usually made of two pieces of ivory, each 6 inches long, and jointed together like the carpenter's rule; it is an instrument but little used at the present time, and, therefore, we will not attempt to enter into a description of if here, but refer for complete information about its construction and use to Heather's Treatise on Mathematical Instruments, page 34.

STRAIGHT EDGES

are rulers the edges of which are very carefully finished to enable the draughtsman to draw a perfectly straight line. They are made of some kind of hard wood or metal. The metal ones can be made more accurately than the wooden ones, because their edges can be ground on iron plates, with emery, and finally finished by grinding the edges of two rules together, also with emery.

In order to ascertain whether a straight edge is perfectly true, take two of them and place one edge of one against an edge of the other, and hold them up between the eye and the light, and observe if any light can be seen between the edges; all the edges should be tried in the same manner.

TRIANGLES

are used for laying off angles, and with a straight edge for drawing parallel lines. They are made of hard wood, rubber, or metal, and are either solid or with open centre; the angles are usually 30, 60, and 90 degrees, or 45, 45, and 90 degrees; the length of the sides vary from 5 to 12 inches. The wooden triangles are lighter, less expensive, and less liable to soil the paper than the metal, but cannot be made so accurately; the wood triangles are also apt to warp and become incorrect by wear in using. The advantage of the open over the solid triangles is, when of wood that they are less liable to warp, and if of metal they are lighter; besides these reasons, they do not conceal so much of the drawing, and in using them the draughtsman can see better how to draw his lines. To see if the right angle of a triangle is correct, draw a straight line, and bring the edge of one of the sides exactly on it, having the right angle about the middle of it; then draw a line along the other side, from the right angle; now, it is to be supposed there is a right angle on each side of the last line drawn; to prove it, take up the triangle and place it in the same position it occupied before, but on the opposite side of the last line; now, if the angle of the triangle is not 90 degrees, when one side corresponds with its line the other will not. To prove the angle of 30, see if it is one-third of 90, and the angle of 60 should be double of the 30 angle.

The edges of the triangle can be tested in the same manner as the edges of a straight edge. The simplest way to test the right angle of a triangle is by the right angle of the T square, one edge of the triangle being held against the blade and the two right angles brought together; the other side of the triangle should fit evenly on the head of the T square; the other plan is the most correct, as there may be an error in the angle of the T square. The triangle is one of the most useful articles in a draughtsman's set of instruments.

IRREGULAR CURVES

are made of wood, horn, or rubber; a variety of curves are cut upon the outer edges, and pieces are cut from the body in such a manner that there is a curve for every side of the opening. These curves are much used in design drawing, also for architectural drawing; some little use is made of them in civil engineering. The various patterns are fully illustrated in our Catalogue.

T SQUARES

are usually made of hard wood or rubber, and are of three different kinds. The first kind has the cross-piece or head fastened permanently and securely at right angles to the straight edge or blade. The second kind has the head attached to the blade by a clamp-screw, which allows the head to be fixed at any angle to the blade, and firmly clamped where fixed. The third kind has the head permanently and securely fastened at right angles to the blade, and a secondary head of the same size attached to it with a clamp-screw, and thus, when other angles than right angles are to be made, the movable head can be fixed at the proper inclination to the blade, while a right angle is still maintained by the fixed head. In the first two kinds the blade is fixed to one of the flat sides of the head, and when used, the edge of the head comes against the side of the drawing board, while the blade lies evenly on it; in the third kind the blade is attached between the two parts of the head, so that in using either the fixed or movable side there is an edge to come against the drawing board, while the blade rests on the board.

The T square is always used in connection with a drawing board, and with it and a triangle all the straight and parallel lines of a drawing are very easily added; the head of the T square being held against the edge of the board, and the triangle resting against the edge of the blade, along which it can be slid for making parallel lines; by sliding the head along the edge of the drawing board other parallel lines can be drawn. The edges of the blade of the T square are apt to get rough from constant use; to prevent this, and also to make the blade stiffer and less liable to warp, a thin strip of brass is set into the edges, and finished off smooth and true.

The angles of the T square should be tested in the same manner as the angles of a triangle, and the edges of the blade as the edges of a straight edge.

PARALLEL RULERS

are of two kinds; the first and most common consists of two straight edges, of ebony or metal, from six to twenty-four inches long, by three-quarters of an inch to one and a half inches wide, joined together by two parallel strips of brass, which move upon pivots at the points where they are attached to the rulers; thus, when the bars are put apart they are always held parallel to each other by the brass strips, consequently, if the edge of one of the bars is brought to a line and firmly held there, and the other bar pushed away from it, a line or lines drawn by the second bar will be parallel to the original line.

ROLLING PARALLEL RULERS.

The other form is a solid straight edge, from nine to eighteen inches long by two inches wide, made of a thick piece of ebony wood or metal; this is mounted upon two small rollers, of equal diameters, one near each end, and both revolving upon one axis. If one edge is brought to a line, and the ruler is pushed from it, the two rollers, being of equal size and on the same axis, will move both ends along the paper with equal rapidity; and any lines drawn in the new position will be parallel with the first line.

Some of this form of parallel rulers have the edges graduated, which is very convenient in many kinds of drawings; the circumferences of the wheels are often graduated for the purpose of drawing a number of parallel lines at the same distance apart.

FASTENING TACKS

are small nails used for fastening the paper to the drawing board; they have large, flat heads and very small, sharp points; the heads are round and made of brass, German silver, or steel, and the points of the best-tempered steel, carefully sharpened. In putting them into the drawing board, the point should be well started with the fingers, and the pin pushed home with a small bottle cork. If the thumb is used for pressing them in there is danger of the upper part of the pin coming through the head and injuring the thumb.

A new form of fastening tack has just been introduced; it is a right-angled piece of metal, each side of which is one-half an inch long, with three points; it is intended for fastening the paper at the corners.

HORN CENTRES

are circular pieces of very thin, semi-transparent horn, about one-half an inch in diameter, with very short and delicate steel points projecting from one side. They are used to put over the point which is to be the centre of several circles or arcs; the centre point can be seen through the horn, and the point of the dividers can be put directly on the centre point; but the paper is shielded from being punctured and disfigured by frequent use of the same hole as a centre.

THE DRAWING BOARD.

A good drawing board is indispensable to the draughtsman. The qualities it is necessary that it should possess are an equal surface and perfectly straight edges at right angles to each other. For these reasons the best drawing board is that which will leave the wood free, so as to allow these changes to take place without affecting the surface or square of the board. This is nearly effected by those described under No. 680 of our Catalogue. In addition to the above described form, we have the Clamped Drawing Board, shown and priced in No. 676 of our list, and the Dovetailed Board, as described in No. 677. The Paneled Drawing Board, shown in illustration No. 679, is a rectangular frame of walnut with an open centre, into which a soft pine board, carefully planed and perfectly smooth, is fitted and fastened in with buttons. The frame is made of hard wood, so as not to wear easily and become incorrect, and the centre of soft wood, so that the fastening pins can be easily put in. The angles and edges of the frame should be as correct as possible; though a little inaccuracy in these respects is not very important, as only one side is used for resting the head of the T square against, and the lines which would require another side to be used are added with the triangles and the dividers. All of our boards are made of the very best, well seasoned, straight-grained pine wood, especially selected and steam-dried for the purpose.

AMSLER'S POLAR PLANIMETER.

By means of AMSLER'S POLAR PLANIMETER a person entirely ignorant of Geometry may ascertain the area of any planimetrical figure, no matter how irregular its outlines may be, more correctly and in much shorter time than the most experienced mathematician could calculate it.

The management of the instrument can be easily learned in half an hour, and in size it is no larger than a two-feet folding rule.

The Planimeter indicates square feet or square inches, and acres for surveying.

DIRECTIONS.—Preparatory to the use of the instrument, ascertain its state:—The index roller D must play easily without coming in contact with the nonius (or vernier). The screw centres, on which its axis revolves, must be adjusted so as to allow perfect freedom of rotation; the same is to be observed for the centre pin C.

The needle point E ought to project but very little from its socket. Great care must be taken not to bend any part of the instrument.

To ascertain the area of a figure in square inches, slide the square rod A into the tube H, so that the line marked 10 sq. in. (10 square inches) stands fair with the beveled part of the tube J. Then set the instrument on the paper, so that the index roller D, the tracing point F, and the needle point E rest on the paper; press the latter point a little on the paper, not enough to pierce it through. This point is to remain stationary during the whole operation. Set the tracing point F on any point P of the outline, and mark that point, and read off the state of the counting wheel G, and the index roller D. Suppose the counting wheel indicates 3 (as in cut), the index roller 905 (90 degrees to be read on the index roller, and 5-10 on the nonius) so that the O of the nonius stands on 90 5-1000 of the circumference of the index roller. Write down the number just read off, thus, 3,905.

Now follow with the tracing point F, the outline of the figure, or part of the figure, to be measured, with great exactness, in the same direction as the hands of a watch would move, until you arrive at the starting point.

Straight lines may be followed along a rule; then read off again the state of the indicators. Suppose you find now 5,763, *i. e.*, the counting wheel indicating 5, and the index roller and nonius 76 3-10 degrees. From these two readings the area found is to be obtained, and here two points are to be considered.

A. If the needle point E is outside of the figure just traced round, the first number (3,905) is to be deducted from the second number (5,763).

5,763
3,905 and the remainder (1,858) is to
be multiplied by ten equal
18,58: ———
which is the area desired, 1,858

B. If the needle point E is inside of the outlines of the figure, add to the number last read off (5,763) the number marked on the side of the square rod next to where 10 sq. in. is marked on the upper side.

In this case it is 20,240, the last number 5,763 read off
The number on side 20,240
———
26,003 Deduct from this
amount the number first read off 3,905
———
22,098

Multiply this remainder by ten, equal 220,98, and this is the amount of square inches, or area of the measured figure.

It is of no consequence whether the roller moves inside or outside of the outlines of the figure, provided it moves on a smooth surface even with the figure.

To obtain the area in square feet, slide the square rod into the tube up to the line marked 0,1 sq. ft. or 0,5 sq. ft. In this case the difference between the first and second readings of the indicators is to be multiplied by 0,1 or 0,05. If the difference, for instance, is 4,653, the rod being up to the line marked 0,1 sq. ft., then is 4,653×0, 1 = 0,4653 equal to the area in decimal fractions of a square foot.

If the needle point is within the outlines of the figures as described in B, proceed the same way as at B, but multiply by 0,1 or 0,05.

If the figure to be measured is at a reduced scale, the result has to be multiplied by the square of the proportion of the reduction. If the proportion of the figure to the full size is as 1:10, the result is to be multiplied by $10^2 = 100$— for instance: the result of the first example is 1,858, which multiplied by 100, (1,858 × 100) = 1858 sq. inches, would be the amount of the area.

If the amount of acres is to be ascertained, the proportion of the reduction being 1:1000, slide the square rod up to the line marked 2 ac 1:1000 or 1 ac., and operate as indicated above: the result is to be multiplied by 1 or 2 instead of 10 or 5. If the rod is set up to the line marked 1 ac., no multiplication is necessary.

Should the plan of the piece of land be drawn on a smaller scale than 1-1000, for example 1-5000th, then multiply the result with the square of the proportion of the reduction to the scale of 1-1000. Thus far the scale of 1-5000 the result would have to be multiplied by $5 \times 5 = 25$ (1-5000 being to 1-1000th as 5-1). If the scale is 1-500th multiply the result by $\frac{1}{2}^2 = \frac{1}{4}$, that is to say, divide the result by 4.

Remark.—If on reading off the horizontal or counting wheel G the indicator points near the middle line between two fingers, say between 3 or 4, then see how the index roller stands to the nonius. If the 0 on the nonius is on the lower side of the 0 of the roller, therefore near 100, then read 3, but if the 0 on the nonius is on the upper side, therefore near 0 on the roller, then read 4 for unity.

If the horizontal wheel turns on its axis during the tracing operation so that it goes beyond 0 (in fact 10), and even marks several revolutions and then stops at any number, for instance 7, you read 17 or 27, etc., adding as many times ten as the wheel has made full revolutions.

It is easy to notice the number of revolutions. If the wheel G marks 6, and the roller D is, for instance, on 0 degrees, 7-10 degrees, or on 4 degrees 7-10 degrees, then the reading is of course 6,007, or 6,047, the number read off the nonius always taking the third place after the units.

The cut shows the instrument two-thirds the natural size.

Draftsmen, engineers, surveyors, ship-builders, architects, machinists will please devote *a few moments* only to the examination of this instrument, and they will at once be convinced of its great importance and value.

CROSS SECTION TRIANGLES AND BATTER ANGLES

are a series of angles constantly recurring in railroad engineering. The Cross Section Triangle has its base and perpendicular proportional to each other, and is used for drawing cross sections of cuttings and embankments.

Batter Angles are used for drawing the batter or slope in rock cuttings, walls, and piers.

RAILROAD CURVES

are thin pieces of wood or card-board cut into arcs of circles of radii from 2 to 250 inches; they are generally made from 3 to 18 inches long by 2 inches wide, the length increasing with the radius.

For description of the different kinds of Drawing Paper, Colors, Brushes, Pencils, etc., their use and how to use them, we would refer to Warren's Manual of Drafting Instruments and Materials, on page 114 of this Catalogue.

POCKET COMPASSES

are small compasses, of sizes not too large to be carried with convenience in the pocket, and are very useful in traveling, in order that the relative positions of places may be known at all times. They are made of a great variety of plans and forms; as without stop and with stop to needle; with covers to face and without; with agate centres to needle and without, and with graduated dials and without. The stop to the needle is an arrangement by which the needle can be lifted off the centre pin and held tightly against the glass face, when the compass is not in use, and thereby prevent the rapid dulling of the point and wearing of the centre, which takes place when the needle is constantly in motion. The object of the cover is to prevent the glass which covers the face from getting broken and the compass injured in other ways. The agate centre is a watch jewel, fixed in the centre of the needle, where it sets on the centre pin; the jewel, being very smooth and hard, causes the needle to vibrate and settle more correctly, and does not become worn by the point, though in constant use. The object of the graduated dial is to give the exact bearing of a place from a given point.

THE UNIVERSAL SUN-DIAL

is a pocket compass, over the face of which a metal rim is hinged, having its upper surface divided into the proper divisions to represent hours and minutes; a straight pin is fixed in the centre of the rim or dial, upon a bar, the ends of which revolve in the edge of the rim; when in use the pin is upright, and when not in use is turned down level with the rim. A graduated arc of 90 degrees is attached to the compass face and passes through the outside edge of the dial rim; this arc is jointed at its base, so that it can be laid flat when the instrument is not in use. To use this form of sun-dial, place it in the sun, as nearly level as possible; raise the graduated arc, then raise the dial rim, and bring the arrow on its outer edge to the degree on the arc which represents the latitude of the place; now lift the pin perpendicular to the plane of the dial rim and turn the compass box around until the blued end of the needle is directly over the North line; the shadow of the upright pin will then be thrown across the dial rim, and the graduation which it falls upon will be the time of day.

PRISMATIC AZIMUTH COMPASS.

With this instrument horizontal angles can be observed with great rapidity and with considerable degree of accuracy. It is, consequently, a very valuable instrument to the military engineer, who can make his observations with it while holding it in his hand with all the accuracy necessary for a military sketch. It is also a useful instrument for filling in the detail of an extensive survey; after the principal points have been laid down by means of observations made with the transit instruments, and for any purpose, in short, in which the portability of the instrument and rapidity of execution are of more importance than extreme accuracy.

For a complete description of the instrument and how to use it see p. 115 Heather's Treatise on Mathematical Instruments.

GEOLOGICAL COMPASS.

This is an ordinary pocket compass, to which is added attachments for taking angles of inclination in the strata of rocks. It is from two to two and a half inches in diameter, and has a ring like a watch; the dial is a metal rim, raised about one-eighth of an inch from the bottom of the compass and divided into 360 equal parts or degrees; the needle has an agate centre and stop attachment. The bottom, or rather the face of the compass, is divided into 90 equal parts or degrees, from the North line to the West line, and also into the same number from the West to the South line—the O point being at the West line. A delicate pendulum, with pointer, swings upon the centre pin and traverses the arcs on the face. Through the ring of the compass box a metal slide is fixed, which pushes in under the bottom plate of the face. When the instrument is to be used for taking inclinations pull out the metal slide and place the compass box upright, and resting on its edge and the slide; if the surface on which the box is placed is perfectly level, the pendulum on the face will hang directly over the O point, but if the strata dips North or South, the index on the pendulum will point at the graduation which indicates the angle of inclination.

THE MINERS' COMPASS

consists essentially of a dipping needle, about 2½ inches long, which inclines toward any mass of iron and thus discovers its position.

When used for tracing ore, the observer should hold the ring in his hand, and keep the needle north and south, standing with his face to the west.

If held horizontal it serves, of course, as a Pocket Compass, having also a brass cover not shown in the cut.

THE POCKET COMPASS WITH SIGHTS.

This little instrument, shown with jacob-staff socket in fig. 962, though not used in extensive surveys like the larger compasses we have described, is found very convenient in making explorations or in retracing the lines of government surveys, as in locating land warrants, etc.

The sights are made with a slote and a hair, on opposite sides; they also have joints near the base, so as to fold over each other above the glass, when the compass is packed in its case.

The circle is graduated to degrees and figured from 0 to 90 each way, as in the larger instruments.

The needle is suspended upon a jeweled centre, and is raised by the lifter shown in the cut.

The jacob-staff socket is often used with the compass, being screwed to the under side and detached at pleasure.

The mountings are all that are furnished, the staff itself being easily made out of a common walking-stick.

We make two sizes of the pocket compass, differing mainly in the needle, which in one is two and a half, in the other three and a half inches long.

As a reading Vernier Pocket Compass with sights, this instrument has also a three and a half inch needle, and is furnished with a vernier outside, reading to five minutes, by which the sights can be placed at any desired angle with the line of zeros, so as to set off the variation of the needle, as with the Vernier Compass.

The compass is furnished with jacob-staff mountings; sometimes, if desired, with a very light tripod; has two levels, and is neatly packed in a mahogany case.

It makes a most excellent and portable little instrument in locations, and is especially useful for the surveyor of Government lands.

THE ARCHITECT'S LEVEL.

No. 1009, as shown in our Catalogue, represents a simple form of leveling instrument, very well suited for giving the levels in building or ditching, or whenever the greatest accuracy is not required.

The instruments are shipped in complete order, but in case they should, at any time, require adjustment, the directions for the Engineer's Level will apply also to these.

TO USE THE LEVEL.

The instrument should be set up firmly upon the tripod or trivet, and in a position as nearly level as practicable—the telescope placed over either pair of leveling screws, and the bubble brought into the centre by turning the opposite screws with the thumb and fore-finger of each hand, the thumbs being both turned in or out as may be needed, and both screws brought to a bearing in the little cups underneath. Having brought the bubble into the centre of the vial, turn the telescope over the other pair of screws and repeat the same operation.

If the bubble runs to either end, bring it half way back by the capstan-head screws at the ends, and go over the adjustment until the bubble will stand in the centre in every position, when the instrument will be ready for use.

Now, bring the object and eye-glasses into focus upon the object as before described, and the horizontal cross-wire will give any number of points required, which will all be in the same level-line.

A long strip of board, held erect, will answer as a rod, and a line in pencil drawn across it at the part cut by the horizontal wire will give the height of the starting point; and any different points on the rod, either above or below indicated by the cross-wire, will show the difference in height of the various points assumed, as compared with the starting point.

In laying off angles with the level, the bubble should first be brought into the centre as before described, and the vertical cross-wire made to cut the object or line from which the angle is to be taken. Then the spindle being clamped by the little milled head-screw under the circle, the circle is turned around by hand, until the zero or centre points of both the circle or vernier are made to coincide—then loosen the clamp screw, turn the telescope to the point desired, and the angle between the two points will be read off on the circle.

The point underneath the Level is easily indicated by the point of the plummet suspended from the tripod.

Of course, it will be understood that, by the use of the vernier, angles can be read on the circle to five minutes of a degree, but ordinarily only even angles will be taken, and the centre line of the vernier will alone be used.

In many situations, after the walls of a building have been carried up to any required height, it becomes difficult to set up the tripod, and in this case the Level is screwed upon the little trivet, which can be set upon the wall, or a piece of board, tacked to the building, or, indeed, upon any surface nearly level and not less than six inches square.

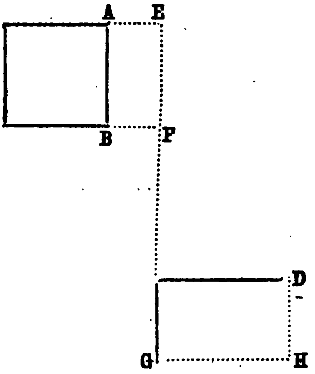
To illustrate the value of this instrument in laying out the sites of buildings, let it be supposed that it is desired to erect a building C D at right angles to a building A B, and at a given distance from its front:

First set up the level at E, and carefully centre the bubble, the point of the plummet below indicating the required distance of the side of the new building from the front A B.

Next, measure off the same distance at the other corner of A B, and having erected the rod, sight upon it with the telescope, and clamp to spindle.

Now, carry the rod the required distance from B, and move it from side to side, until it is again in line with the telescope, as at C.

Remove the instrument, and having carefully set it over the point C by the plummet, and brought the bubble into the centre as before, set the telescope again upon the rod placed at E or F, clamp to spindle, bring the circle to 0 with the zero of the vernier—unclamp and turn the vernier to 90 degrees—it will give a point D at any required distance from C, and C D will be the side of the proposed building. The side C G is determined by turning the telescope around until the vernier is in line with the other 0 of the circle, and thus the corner C and the two sides, C D and C G, are at once set off, and the remaining corner, H, easily ascertained by making D H and G H equal to C D and C G.



Other applications of the Level, as the setting of floor timbers, of window and door sills, the leveling of floors, etc., etc, will readily occur to one who has been engaged in building, where it can be made of very great and increasing advantage, as he becomes familiar with its use.

To the millwright such a Level is almost indispensable in the lining and leveling of shafting, the ascertaining of the fall of water attainable, and the overflow of land by a millpond, which may be determined upon.

The extensive farmer will find it of great value in laying out drains, determining their location, the heights of springs, etc.

Indeed, we believe that as this little Level shall become more widely known, its extreme cheapness, simplicity, and excellence will create for it among all intelligent and enterprising architects, builders, millwrights, and farmers a demand which will constantly increase in all parts of the country.

Such has been our hope in thus introducing it to the public at a price which will only become remunerative by inducing a widely extended sale.

CARE OF INSTRUMENTS.

The usefulness of an instrument can be preserved for many years if proper care is taken of the same. We shall, therefore, mention a few of the principal points which the engineer will do well to observe.

To preserve the sensitiveness of the needle, the drilling of the centre pin must be avoided. The instrument should never be lifted without being sure the needle is up, and if by letting it down again the swing is too large, it should be gently stopped when within a few degrees of its natural bearing. Should the point become dull, it is best to have it fixed by an instrument-maker; if such, however, is not accessible, or no time can be spared, a watchmaker perhaps can do it. It must be remembered, however, that after being sharpened the point must be centered, that is, must be brought in the centre of the graduation. This work, however, can only be relied upon if done by the instrument-maker.

If a needle is made of good steel, well hardened and properly charged, it will not often lose its magnetism; and if, when placed away, it is always brought to lie in the meridian, it will retain, or even increase its polarity. It should not be left resting on the point, but after it has assumed its position it should be raised against the glass. If a needle has lost its magnetism it can be charged again with an ordinary horse-shoe magnet; one of three inches in length will be suitable for this purpose. The operation is this: hold the magnet with the poles upward, then with a gentle pressure pass each pole of the needle from centre to extremity over the opposite pole of the magnet, describing, before each pass, a circle with a diameter of about double the length of the needle, taking care not to return it in a path near the pole. If the magnet is strong enough the needle need not be taken out at all, but by raising it against the glass and then passing the magnet over this, it will be charged sufficiently. After charging, the needle has lost its balance, which can easily be restored by shifting the brass wire on the south end.

The general tendency in the use of screws is to overstrain them. This should never be done, especially with the cross-wire screws, which, when too much tightened, are liable to constant change and loss of adjustment. Leveling and clamp screws also should not be overstrained, as it wears them out sooner and sometimes causes fretting. If this takes place, they should be taken out and brushed with either soap and water or benzine. The nuts can best be cleaned by screwing a flat piece of soft wood through their apertures. In putting together grease them slightly.

Fretting of the centres and of the telescope-slide will interfere more with a correct working of the instrument than any other part out of order. They should be watched, therefore, very closely, and as soon as any rough motion manifests itself it should be remedied at once, if possible, by an instrument-maker. If this cannot he had, and the fretting is in the slide, first scrape and then burnish down the place where it frets. It may also be ground slightly with oil and very fine pumice-stone dust, which is best obtained by rubbing two pieces on each other. After grinding them a little the tubes should be cleaned and placed together again, with oil only, then move them in and out a number of times, wipe the oil off, and finally put them together when dry. If the fretting takes place in the centres (when properly made and constructed, so that they do not come apart in detaching the instrument from the tripod, this will never happen), employ the same means, and if this is not effective, place a washer, made of paper or a thin card between the shoulders. This will cause a shake, making accuracy impossible, and produce errors of parallax in reading off, which, however, is better than destroying the centres wholly. The best grease for centres is very fine watch oil. In regard to our centres, we can say that no fretting will ever happen, as they are always covered and carefully made. The object-slide should not be greased. Never use emery paper or emery in repairing any movement, as it cannot be removed again and will grind continually. For greasing, leveling, and clamp screws, pinions, etc., good rendered marrow should be used.

In cleaning object and eye-piece glasses, use a soft rag or chamois leather. If the glasses should become greasy or very dirty, wash them with alcohol. The inside of the glasses will very seldom require cleaning, and it is advisable not to take the telescope apart often, as it destroys adjustment, especially in those instruments in which the object-glasses are loose in the cell. If dust should settle on the cross hairs it is best not to touch them. The only means which may be tried is by taking out the object-glass and eye-piece and blowing gently through the tube. If one or both cross hairs should break, and no instrument-maker is near by, take a pair of compasses and put a little beeswax on the ends, on which the hair will easily stick. Then place it on the diaphragm so that it gets strained sufficiently to become straight, and fasten it by putting some binding material which quickly dries—for instance, lacquer, on it. For dusting off an instrument a camel's-hair brush is best suited. It will brush dust better out of the corners than can be done with a rag and preserves the lacquer. Its use is especially recommended for cleaning limb, vernier, and compass ring.

It is advisable to look sometimes after the fitting of legs and shoes. If there is any shake in the legs, or any shoe loose, the instrument cannot be steady.

There should be no delay in repairing defects.

If an instrument is upset, bending centres and plates, do not turn it unnecessarily, as it will spoil the graduation, but send it to a competent instrument-maker immediately.

(The greater portion of the following pages we have been kindly permitted to copy from Messrs. W. & L. E. Gurley's very excellent book, the "AMERICAN ENGINEERS' AND SURVEYORS' MANUAL.")

For a full and complete description of the Solar Compass and Engineers' Transit, alluded to in the text, see the Manual as above.

CHAPTER XVI.

SURVEYING INSTRUMENTS.

THE various instruments used in Surveying may be conveniently arranged into two general divisions.

(1.) NEEDLE instruments—or such as owe their accuracy and value to the magnetic needle only, embracing the Plain and Vernier Compasses and the Vernier Transit.

(2.) ANGULAR instruments, including those in which the horizontal angles are measured by a divided circle and verniers, as well as by the needle also; as the Railroad Compass. Surveyors' and Engineers' Transits, etc.

In the present work we shall consider first those instruments comprised in the first division, and as in these the accuracy of the horizontal angles indicated depends upon the delicacy of the needle and the constancy with which it assumes a certain direction, termed the "magnetic meridian," we shall here remark briefly upon the *form*, the *length*, and the *movement* of

THE MAGNETIC NEEDLE.—The *forms* of the needle are almost infinitely varied, according to the taste or fancy of the maker or surveyor, but may be resolved into two general classes, one having the greatest breadth in a horizontal, the other in a vertical direction.

We have usually made our needles about one-twentieth of an inch broad and one-third as thick, parallel from end to end, the north and south poles being distinguished from each other by a small scollop on the north end.

Of course, the form of the needle is always varied according to the choice of our customers and without additional charge.

The *length* of the needle varies in different instruments, from four to six or even seven inches, those of five and a half or six inches long being generally preferred by surveyors.

The *movement* of the needle with the least possible friction is secured by suspending it by a steel or jewel centre upon a hardened steel pivot, the point of which is made perfectly sharp and smooth.

The test of the delicacy of a magnetic needle is the number of horizontal vibrations which it will make in a certain arc before coming to rest—besides this, most surveyors prefer also to see a sort of quivering motion in a vertical direction.

This quality, which is manifested more in a horizontal than in a vertical needle, and depends upon the near coincidence of the point of suspension with the centre of gravity of the needle, serves to show merely that the cap below is unobstructed.

Having now considered the different qualities of a good needle, we shall proceed to speak of those instruments of which it makes so important a part. Of these, the most simple is that termed the

PLAIN COMPASS.

The Plain Compass has a needle six inches long, a graduated circle, main plate levels and sights, and is placed upon the brass head of the "Jacob-staff."

The Compass Circle in this, as in all our instruments, is divided to half degrees on its upper surface, the whole degree marks being also cut down on the inside circumference, and is figured from 0 to 90, on each side of the centre or "line of zeros."

The circle and face of the compass are silvered.

The Spirit Levels are placed at right angles at each other so as to level the plate in all directions and are balanced upon a pivot underneath the middle of the tube, so as to be adjustable by a common screw-driver.

The Sights, or standards, have fine slits cut through nearly their whole length, terminated at intervals by large circular apertures, through which the object sighted upon is more readily found. Sometimes a fine horse-hair or wire is substituted for one-half the slit, and placed alternately with it on opposite sights.

Tangent Scale.—The right and left hand edges of the sights of our compasses have respectively an eye-piece and a series of divisions by which angles of elevation and depression, for a range of about twenty degrees each way, can be taken with considerable accuracy.

Such an arrangement is very properly termed a "tangent scale," the divided edges of the north sight being tangents to segments of circles having their centres at the eye-pieces, and their points of contact with the tangent lines at the zero divisions of the scale.

The Jacob-staff mountings, which are furnished with all our compasses and packed in the same case, consist of the brass head already mentioned and an iron ferule or shoe, pointed with steel, so as to be set firmly in the ground.

The staff, to which the mountings should be securely fastened, is procured from any wheelwright or selected by the surveyor himself from a sapling of the forest.

TO ADJUST THE COMPASS.

The Levels.—First bring the bubbles into the centre by the pressure of the hand on different parts of the plate, and then turn the compass half-way around; should the bubbles run to the end of the tubes, it would indicate that those ends were the highest; lower them by tightening the screws immediately under, and loosening those under the lowest ends until, by estimation, the error is half removed; level the plate again, and repeat the first operation until the bubbles will remain in the centre during an entire revolution of the compass.

The Sights may next be tested by observing through the slits a fine hair or thread, made exactly vertical by a plumb. Should the hair appear on one side of the slit, the sight must be adjusted by filing off its under surface on that side which seems the highest.

The Needle is adjusted in the following manner: Having the eye nearly in the same plane with the graduated rim of the compass circle, with a small splinter of wood or a slender iron wire, bring one end of the needle in line with any prominent division of the circle, as the zero or 90 degree mark, and notice if the other end corresponds with the degree on the opposite side; if it does the needle is said to "cut" opposite degrees; if not, bend the centre-pin by applying a small brass wrench, furnished with our compasses, about one-eighth of an inch below the point of the pin, until the ends of the needle are brought into line with the opposite degrees.

Then, holding the needle in the same position, turn the compass half-way around, and note whether it now cuts opposite degrees; if not, correct half the error by bending the needle and the remainder by bending the centre-pin.

The operation should be repeated until perfect reversion is secured in the first position.

This being obtained, it may be tried on another quarter of the circle; if any error is there manifested, the correction must be made in the centre-pin only, the needle being already straightened by the previous operation.

When again made to cut, it should be tried on the other quarters of the circle, and corrections made in the same manner until the error is entirely removed, and the needle will reverse in every point of the divided surface.

TO USE THE COMPASS.

In using the compass the surveyor should keep the south end toward his person, and read the bearings from the north end of the needle. He will observe that the E and W letters on the face of the compass are reversed from their natural position, in order that the direction of the line of sight may be correctly read.

The compass circle being graduated to half degrees, a little practice will enable the surveyor to read the bearings to quarters, or even finer—estimating with his eye the space bisected by the point of the needle, and as this is as low as the traverse table is usually calculated, it is the general practice.

Sometimes, however, a small vernier is placed upon the south end of the needle, and reads the circle to five minutes of a degree—the circle being in that case graduated to whole degrees.

This contrivance, however, is quite objectionable on account of the additional weight imposed on the centre pin and the difficulty of reading a vernier which is in constant vibration, and is therefore but little used.

To TAKE ANGLES OF ELEVATION.—Having first leveled the compass, bring the south end toward you, and place the eye at the little button, or eye-piece, on the right side of the south sight, and with the hand fix a card on the front surface of the north sight, so that its top edge will be at right angles to the divided edge and coincide with the zero mark; then, sighting over the top of the card, note upon a flagstaff the height cut by the line of sight; then, move the staff up the elevation, and carry the card along the sight until the line of sight again cuts the same height on the staff, read off the degrees and half degrees passed over by the card, and we shall have the angle required.

FOR ANGLES OF DEPRESSION.—Proceed in the same manner, using the eye-piece and divisions on the opposite sides of the sights, and reading from the top of the standards.

JACOB-STAFF SOCKET.—The compass is furnished with a ball spindle, or socket, upon which it turns and by which it is leveled. The ball may be placed in a single or "jacob-staff" socket, as represented in the figure, or in a compass tripod, such as is shown in the cut of the Vernier Transit beyond.

CLAMP SCREW.—In the side of the hollow cylinder, or socket of the compass, which fits to the ball spindle, is a screw by which the instrument may be clamped to the spindle in any position.

SPRING CATCH.—Besides the clamp screw, we have recently fitted to the sockets of our compasses a little spring catch, which, as soon as the instrument is set upon the spindle, slips into a groove, and thus removes all danger of falling when the instrument is carried.

NEEDLE LIFTER.—There is also underneath the main plate a needle lifting screw, which, by moving a concealed spring, raises the needle from the pivot, and thus prevents the blunting of the point in transportation.

When the compass is not in use it is the practice of many surveyors to let down the needle upon the point of the centre-pin, and let it assume its position in the magnetic meridian, so as to retain or even increase its polarity.

We would advise, in addition, that after the needle has settled it should be raised against the glass, in order not to dull the point of suspension.

OUTKEEPER.—A small dial plate, having an index turned by a milled head underneath, is often used with this and the other compasses to keep tally in chaining.

The dial is figured from 0 to 16, the index being moved one notch for every chain run.

ELECTRICITY.—A little caution is necessary in handling the compass, that the glass covering be not excited by the friction of cloth, silk, or the hand, so as to attract the needle to its under surface.

A brass cover is sometimes fitted over the glass of the compass, and serves to protect it from accident as well as to prevent electric disturbance.

When, however, the glass becomes electric, the fluid may be removed by breathing upon or touching different parts of its surface with the moistened finger.

An ignorance of this apparently trifling matter has caused many errors and perplexities in the practice of the inexperienced surveyor.

REPAIRS OF THE COMPASS.

To enable the surveyor to make such repairs as are possible without having recourse to an instrument-maker, we here add a few simple directions:

1. **The Needle.**—It may sometimes happen that the needle has lost its polarity and needs to be re-magnetized; this is effected in the following manner:

The operator, being provided with an ordinary permanent magnet,* and holding it before him, should pass with a gentle pressure each end of the needle from centre to extremity over the magnetic pole, describing before each pass a circle of about six inches radius, to which the surface of the pole is tangent, drawing the needle toward him, and taking care that the north and the south ends are applied to the *opposite* poles of the magnet.

Should the needle be returned in a path near the magnetic pole, the current induced by the contact of the needle and magnet in the pass just described would be reversed, and thus the magnetic virtue almost entirely neutralized at each operation.

When the needle has been passed about twenty-five times in succession, in the manner just described, it may be considered as fully charged.

A fine brass wire is wound in two or three coils on the south end of the needle, and may be moved back or forth in order to counterpoise the varying weight of the north end.

2. **The Centre Pin.**—This should occasionally be examined, and if much dulled, taken out with the brass wrench already spoken of, or with a pair of plyers, and sharpened on a hard oil-stone—the operator placing it in the end of a small stem of wood, or a pin vice, and delicately twirling it with the fingers as he moves it back and forth at an angle of about 30 degrees to the surface of the stone.

When the point is thus made so fine and sharp as to be invisible to the eye, it should be smoothed by rubbing it on the surface of a soft and clean piece of leather.

3. **To Put in a New Glass.**—Unscrew the "bezzle ring" which holds it, and with the point of a knife blade spring out the little brass ring above the glass, remove the old glass, and scrape out the putty; then if the new glass does not fit, smooth off its edges by holding it obliquely on the surface of a grind-stone until it will enter the ring easily; then put in new putty, spring in the brass ring, and the operation will be complete.

4. **To Replace a Spirit Level.**—Take out the screws which hold it on the plate, pull off the brass ends of the tube, and with a knife blade scrape out the plaster from the tube; then with a stick made a little smaller than the diameter of the tube, and with its end hollowed out so that it will bear only on the broad surface of the level vial, push out the old vial and replace it with a new one, taking care that the crowning side, which is usually marked with a file on the end of the vial, is placed on the upper side.

When the vial does not fit the tube it must be wedged up by putting under little slips of paper until it moves it snugly.

After the vial is in its place, put around its ends a little boiled plaster, mixed with water to the consistency of putty, taking care not to allow any to cover the little tip of the glass, then slip in the brass ends and the operation will be completed.

A little beeswax melted and dropped upon the ends of the vital is equally as good as the boiled plaster, and often more easily obtained.

We would here remark that an extra glass and level vials are always furnished, free of charge, with our instruments, whenever desired by the purchaser.

SIZES OF THE PLAIN COMPASS.

Three different sizes of this instrument are in common use, having respectively four, five, and six-inch needles, and differing also in the length of the main plate, which in the four-inch compass is twelve and a half inches long, and in the larger sizes, fifteen and a half inches.

The six-inch needle compass is generally preferred.

WEIGHT OF THE PLAIN COMPASSES.

The average weights of the different sizes, with the brass mountings of the jacob-staff, are

For the 4-inch needle, 6 lbs.
For the 5-inch needle, 7½ lbs.
For the 6-inch needle, 8½ lbs

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*A magnet suitable for this purpose costs from 25 to 50 cents.

The plain compass, which was the only one in use in this country previous to the time of David Rittenhouse, has gradually given way to the superior advantages of the Vernier or Rittenhouse compass, which we shall now proceed to describe.

THE VERNIER COMPASS.

The Vernier Compass, represented in No. 969, differs from the instrument just described in having its compass circle, with a vernier attached, movable about a common centre by turning the "tangent screw," seen at the south end of the plate.

Sometimes a rack and pinion movement is substituted for the tangent screw, and is desirable where frequent changes of the vernier are required. It makes no difference in the price of the compass.

The superiority of the vernier over the plain compass consists in its adaptation to the retracing the lines of an old survey, and to the surveys of the U. S. public lands, where the lines are based on a true meridian.

VARIATION OF THE NEEDLE.

It is well known that the magnetic needle, in almost all parts of the United States, points more or less to the east or west of a true meridian, or north and south line.

This deviation, which is called the VARIATION OR DECLINATION of the needle, is not constant, but increases or decreases to a very sensible amount in a series of years.

Thus at Troy, N. Y., a line bearing in 1830, N. 31° E., would now, 1862, with the same needle, have a bearing of about N. 32° E., the needle having thus in that interval traveled a full degree to the west.

For this reason, therefore, in running over the lines of a farm from field notes of some years' standing, the surveyor would be obliged to make an allowance, both perplexing and uncertain, in the bearing of every line.

To avoid this difficulty the *vernier* was devised, the arrangement of which we shall now describe.

THE VERNIER is divided on its edge to thirty equal parts, and figured in two series on each side of the centre line.

In the same plane with the vernier is an arc or limb, fixed to the main plate of the compass, and graduated to half degrees.

The surfaces of both vernier and limb are silvered.

On the vernier are thirty equal divisions, which exactly correspond in length with thirty-one of the half degrees of the limb.

Each division of the vernier is, therefore, one-thirtieth—or, in other words, one minute longer than a single division of the limb.

TO READ THE VERNIER.—In "reading" the vernier, if it is moved to the right, count the minutes from its zero point to the left, and vice versa. Proceed thus until a division on the vernier is found exactly in line with another on the limb, and the lower row of figures on the vernier will give the number of minutes passed over. When the vernier is moved more than fifteen minutes to either side the number of the additional minutes up to thirty or one-half degree of the limb is given by the upper row of figures on the opposite side of the vernier.

To read beyond thirty, add the minutes given by the vernier to that number, and the sum will be the correct reading.

In all cases when the zero point of the vernier passes a whole degree of a limb, this must be added to the minutes, in order to define the distance over which the vernier has been moved.

TO TURN OFF THE VARIATION.—It will now be seen that the surveyor having the vernier compass can, by moving the vernier to either side, and with it, of course, the compass circle attached, set the compass to any variation.

He, therefore, places his instrument on some well-defined line of the old survey and turns the tangent screw until the needle of his compass indicates the same bearing as that given in the old field notes of the original survey.

Then, screwing up the clamping nut underneath the vernier, he can run all the other lines from the old field notes without further alteration.

The reading of the vernier on the limb in such a case would give the change of variation at the two different periods.

The variation of the needle at any place being known, a true meridian, or north and south line, may be run by moving the vernier to either side, as the variation is east or west, until the arc passed over on the limb is equal to the angle of variation; and then, turning the compass until the needle is made to cut the zeros on the divided circle, when the line of the sights would give the direction of the true meridian of the place.

Such a change in the position of the vernier is necessary in surveying the U. S. public lands, which are always run from the true meridian.

"THE LINE OF NO VARIATION," as it is called, or that upon which the needle will indicate a true north and south direction, is situated in the United States nearly in an imaginary line drawn from the middle of Lake Erie to Cape Hatteras, on the coast of North Carolina.

A compass needle, therefore, placed east of this line would have a variation to the west, and when placed west of the line the variation would be to the east, and in both cases the variation would increase as the needle was carried farther from the line of no variation.

Thus, in Minnesota the variation is from 15° to 16° to the east, while in Maine it is from 17° to 18° to the west.

At Troy, in the present year, 1862, the variation is about 8° to the west, and is increasing in the same direction from two to three minutes annually.

TO READ TO MINUTES.—A less important use of the vernier is to give a reading of the needle to single minutes, which is obtained as follows:

First be sure, as in all observations, that the zero of the vernier exactly corresponds with that of the limb; then, noting the number of whole degrees given by the needle, move back the compass circle with the tangent screw until the nearest whole degree mark is made to coincide with the point of the needle, read the vernier as before described, and this reading, added to the whole degrees, will give the bearing to minutes.

TO USE THE VERNIER COMPASS.

Proceed in the same manner as directed in regard to the Plain Compass, when making new surveys, always taking care that the vernier is set at zero and securely clamped by screwing up the nut beneath the plate.

In surveying old farms allowance and correction must be made for the variation, as just described.

WEIGHT OF THE VERNIER COMPASS.

The average weight of this instrument, with the jacob-staff mountings, is about 9½ pounds.

THE ADJUSTMENTS of the Vernier Compass are mainly those of the instrument first described, and need not here be repeated.

Paine's American standard steel tapes are made of thin, narrow steel ribbon, of a low, straight spring temper, of any required length, and in one piece. They are made of more narrow and heavier ribbon than the Chesterman, and may also be detached from the case and used with a pair of handles, with compensating scale for variations of temperature for chain measurements

The Engineers' chain tape, No. 1084½ in Catalogue, is very useful in measurements of bridge-work, foundations, etc., and in all cases where measurements of long distances are required, and where more accurate results than can be produced with the chain are desired.

They are made in lengths from 100 to 1000 feet, and can be graduated as desired.

NOTE.—A 100-feet tape expands for each 10°, one inch in 1400 feet.

The expansion of each lineal foot for 1° is .000072 of an inch.

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